BEVK

REPORT OF WATER QUALITY IN JERRY LAKE

AN UNCOTTAGED LAKE IN SINCLAIR TOWNSHIP, IN THE MUSKOKA'S 1972-1973.

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1. LIMNOLOGY

REPORT OF WATER QUALITY

IN JERRY LAKE, AN UNCOTTAGED

LAKE IN SINCLAIR TOWNSHIP, DISTRICT

MUNICIPALITY OF MUSKOKA, 1972-1973.

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PREFACE

The Province of Ontario contains many thousands of beautiful small inland lakes which are most attractive for recreational use. Lakes close to urban areas and accessible by road often receive heavy use in terms of cottage development, camp sites, trailer parks and picnic areas.

A heavy influx of people may subject a lake and its surrounding environment to great stress. In some cases, developments are carried out on attractive lakes only to find that when this is complete the lake qualities which were initially so appealing have been damaged. The appearance of the shoreline can be marred by construction, fishing ruined by over-harvesting or by the growth and decay of excessive amounts of algae and weeds. Motor boats introduce noise and petroleum pollution. Inadequate disposal of human wastes can place a great stress on the lake environment.

The accepted custom of having "a place at the lake" continues to apply pressure for more development, giving rise to an even greater expansion of problems.

The Ontario Ministry of the Environment is attempting to bring some of these stress factors under control with a variety of programs. The cottage pollution control program was initiated in 1967 and was expanded in 1970 in order to solve the cottage waste disposal problem in recreational lakes. There are three on-going studies carried out by the Ministry.

1. Evaluation of existing waste disposal systems and enforcement of repairs to those found to be unsatisfactory.

2. Research to improve the knowledge of septic tank operation and effects in shallow soil areas and evaluation of alternative methods of private waste disposal.

3. Evaluation of present water quality in a number of recreational lakes.

This report on Jerry Lake, a totally undeveloped lake near Huntsville, provides information about natural water quality within a Precambrian Shield Lake and should assist in defining any unnatural characteristics encountered in similar, but developed lakes. A more detailed

treatment of the limnology of the lake is presented elsewhere[1].

SUMMARY

Surveys were carried out during both 1972 and 1973 to evaluate the bacterial, chemical and biological quality of the waters of Jerry Lake. Jerry Lake is totally undeveloped (no cottages) and the work was undertaken to provide information about natural water quality of Precambrian Shield Lakes and to assist in defining any unnatural characteristics encountered in similar, but developed lakes.

Jerry Lake is located in Sinclair Township, east of the town of Huntsville and is surrounded by privately owned land on the Precambrian Shield characterized by rugged topography and massive outcroppings of hard rock. The lake has a surface area of 0.55 km^2 (140 acres) and has mean and maximum depths of 13.6m and 35m (45 feet and 115 feet), respectively.

The bacteriological water quality of the main body of Jerry Lake was excellent and was well within the Ministry of the Environment's "Microbiological Criteria for Total Body Contact Recreational Use". The bacterial densities in the main body of the lake were low and showed only small seasonal and year-to-year variations. Fecal coliform bacteria were essentially absent from the open lake area. High densities of total coliforms and fecal streptococcus and occasional lower densities of fecal coliforms were found in the inflowing streams and sometimes in the lake at the mouth of these streams. The Recreational Use Criteria for fecal streptococcus was exceeded during all surveys at the mouth of the northern inflowing stream. The densities of fecal bacteria at this location indicated that the input of these bacteria was from an animal or stormwater source and the quantity was small, since nearby sampling locations were not affected. Densities of fecal streptococci increased following rainfall.

[1]<u>Footnote:</u> *Nicholls, K.H. 1976. Comparative limnology of Harp and Jerry Lakes - adjacent cottaged and uncottaged lakes in southern Ontario's Precambrian Shield. Ontario Ministry of the Environment, Water Resources Branch, Toronto, Ontario. 76p. + Appendices.*

Jerry Lake, typical of most other lakes on the Precambrian Shield, is characterized by soft waters of low mineral and nutrient content. Mineral characteristics of the inflowing and outflowing streams differed little from the open lake, but considerable accumulation of iron was found in the near-bottom waters by October. Concentrations of phosphorus increased in the inflowing streams and the surface waters of the lake following heavy rainfall.

Moderately low densities of suspended algae were found in the lake, and aquatic plant growth was restricted to only a few, localized inshore areas. Weedy species of aquatic plants, which are notoriously common to nutrient enriched lakes, were not found in Jerry Lake.

Surface water dissolved oxygen concentrations were frequently at or above 100% of saturation; however, bottom water supplies decreased throughout the ice-free period until by late October, saturations below 10% were found below 15m.

PURPOSE OF THE SURVEYS

Since the inception of the Recreational Lakes Program in 1970, there has been considerable difficulty in establishing the degree of adverse water quality which may occur naturally and the degree of pollution which may result from cottage development of the lakeshore. In particular, there was uncertainty as to whether the large increases in bacteria noted following rainfalls in many of the lakes studied were due to a natural component of surface runoff or to seepage or leaching from sewage waste disposal systems. In order to better understand this rainfall effect, natural processes of nutrient enrichment and seasonal and yearly variations in water quality in Precambrian lakes, Jerry Lake, an accessible uninhabited lake, was studied intensively in 1972 and 1973 with respect to:

- concentration and distribution of bacteria
- plant nutrients and suspended algae
- water quality changes with depth
- density and species of aquatic plants

A more substantiated assessment of the sources of nutrients and bacterial contamination in developed lakes is expected to be achieved when water quality data from Jerry Lake are compared with those from developed lakes surveyed under the Recreational Lakes Programme.

The kind co-operation of the owners of Jerry Lake in consenting to these surveys is very much appreciated.

DESIGN OF THE SURVEY

Sampling Locations and Frequency

A proper estimate of the bacterial population requires several measurements of bacterial densities over a period of time which can then be averaged as a geometric mean. Measurements over 5 consecutive days at each station are regarded as the minimum number which when taken at many lake stations, will give reliable bacteriological results.

During 1972, bacteriological, chemical and biological surveys were carried out from May 21 to May 25; from June 16 to July 30; and from October 17 to October 21. The main surveys during 1973 were from May 23 to June 2; from July 24 to August 3; and from September 10 to September 15. Additional chemical and biological sampling was carried out at approximately bi-weekly intervals during both ice-free and ice-covered periods.

Samples for bacterial analysis were taken daily one meter below the surface at 36 stations established throughout the lake, as well as from one meter above the bottom at three mid-lake stations (Figure 1).

Chemical samples were taken through the illuminated layer of surface water and from one meter above bottom at each mid-lake station, but at the inlet and outlet stations, were collected at mid-depth. During the five day spring and summer surveys chemical samples were obtained on the first and fifth day. Separate samples for chlorophyll analysis were collected daily through the illuminated surface water at the mid-lake and inlet stations.

Aquatic plant samples were obtained from areas representative of sparse, medium and dense growth.

Field Tests

The variations in temperature and dissolved oxygen values with depth were measured at the two deep water stations with an electronic probe lowered into the lake and water clarity was measured with a Secchi disc, (Figure 2). The pH of the samples was also measured in the field.

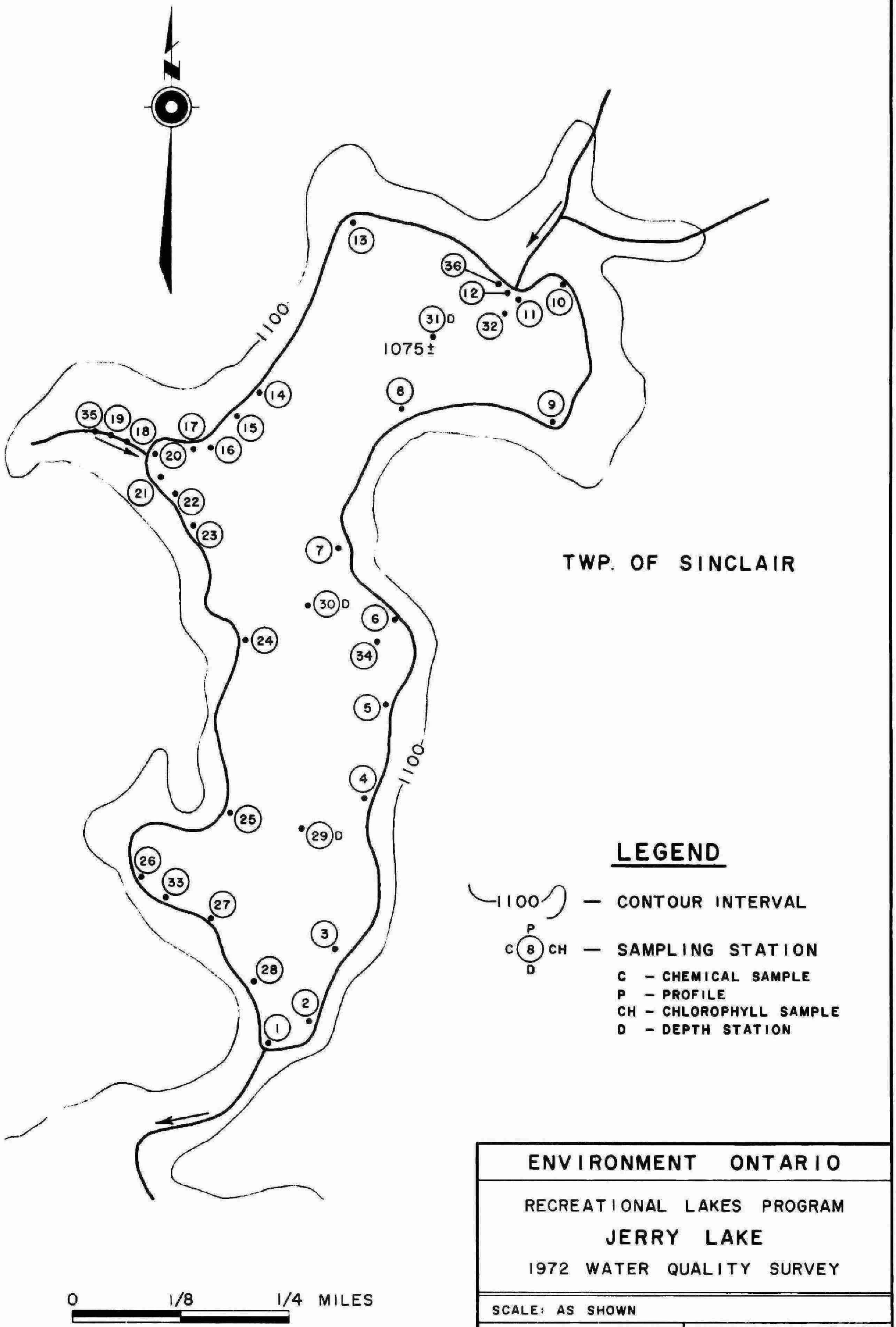
Bacteriological Tests

The numbers of bacteria in each of three types of "indicator" organisms were determined on each sample. The three bacterial types, total coliform, fecal coliform and enterococcus (fecal streptococcus) bacteria are all indigenous to man and other warm blooded animals, and are found in the colon and feces in tremendous numbers. Many diseases common to man can be transmitted by feces, consequently, the probability of occurrence of these diseases is usually highest in areas where the water is contaminated. These indicator organisms in water connote the possible presence of disease causing organisms.

The density (numbers per 100 ml) of the indicator bacteria in water will vary considerably between pairs of samples taken at the same station, or at different stations on a lake, or if taken at different times, and so the assessment of water quality cannot be determined accurately from a single water sample.[1] Therefore, the bacteriological surveys require many samples to be taken at several lake stations over a period of time, and following this the large amount of data so obtained is reduced by calculation to meaningful and easily manipulated statistics.

> These data were then evaluated by statistical techniques in the following manner. The geometric mean, the most appropriate central value, and standard deviation were calculated for the values of each of the three bacterial types at every station, providing concise valid data. Statistically significant variations in the bacterial densities between stations, or groups of stations was determined by a One Way Analyses of Variance and Bartlett's Test of Homogeneity. By these means the data from each station were tested against that of every other station until all stations with similar geometric mean densities were separated into groups (Group A, B ---).

FIGURE 1 - LOCATION OF SAMPLING STATIONS



ENVIRONMENT ONTARIO	
RECREATIONAL LAKES PROGRAM JERRY LAKE 1972 WATER QUALITY SURVEY	
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The "Secchi Disc Reading" is obtained by averaging the depth at which a 23cm (9") dia. black and white plate, lowered into the lake just disappears from view and the depth where it reappears as it is pulled up.

Most of the free-floating algae are suspended in the illuminated region between the lake surface and 2 times the Secchi disc reading.

Clear, algae-free lake: Secchi disc readings tend to be greater than 3m (9 feet).

Turbid or algae-rich lake: Secchi disc readings tend to be less than 3m (9 feet).

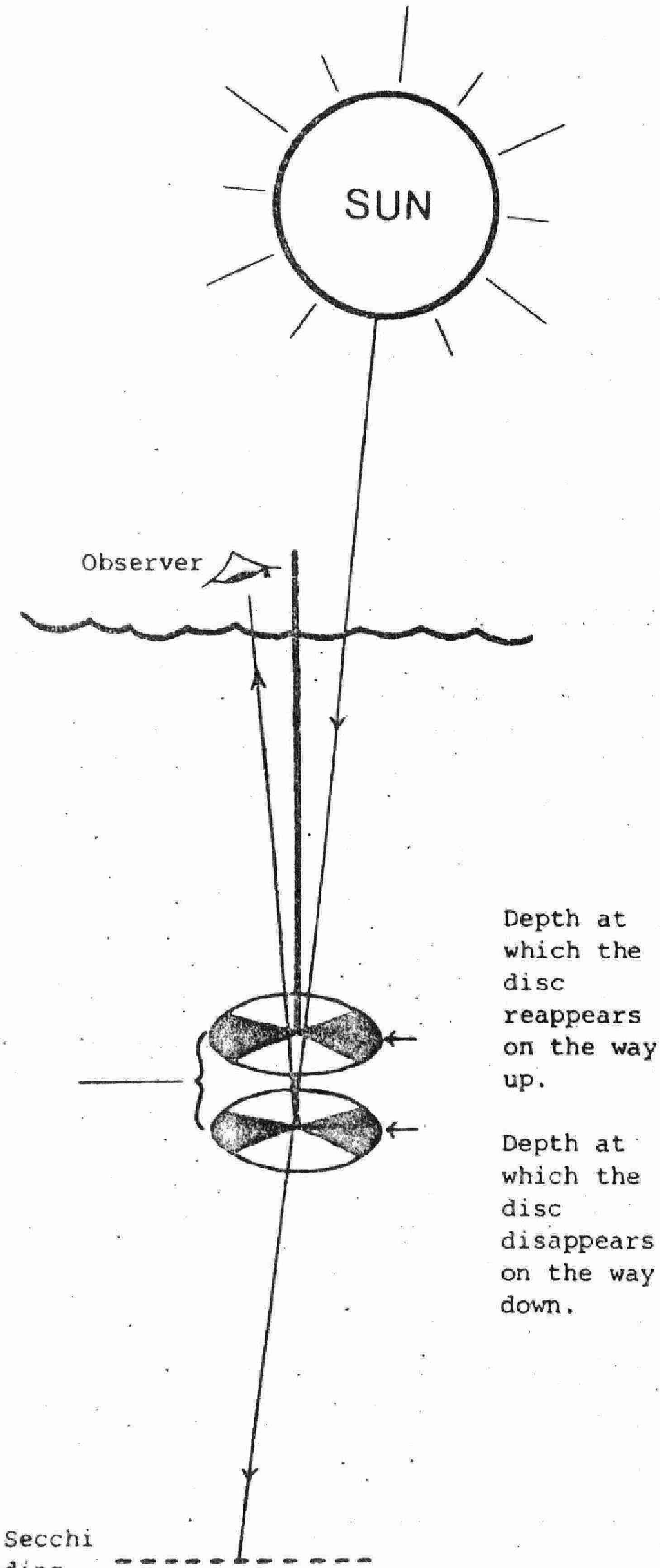


FIGURE 2: USE OF THE SECCHI DISC TO DETERMINE WATER CLARITY.

The group results, and those for individual stations, were then displayed on a map of the lake with each group identified by different stippling. Within each stippled area the group geometric mean applied for each type of bacteria, unless otherwise indicated by individual station values. The areas of better or worse bacterial quality were defined by the group geometric mean densities, and so any inputs of bacterial contamination, and the areas they affect, were readily identified.

Chemical Tests

Hardness, alkalinity, chloride, iron and conductivity were measured in order to define the mineral composition of the water. The types of plants and animals which thrive, effects of toxic materials and suitability of the lake for various management techniques are affected by the mineral content.

Total and soluble phosphorus were measured in the inlet, outlet and mid-lake surface and bottom samples. Soluble phosphorus concentrations were used mainly to substantiate various interpretations of the total phosphorus concentrations.

The total Kjeldahl nitrogen is (apart from ammonia nitrogen) essentially the amount of nitrogen contained in organic material. It was measured in all of the chemical samples. The soluble forms of nitrogen (Ammonia, Nitrite and Nitrate) were measured as well. They are particularly important in bottom waters since nitrogen may be regenerated from decaying organic matter in these forms.

Chlorophyll a concentrations are an indication of the amount of suspended algae in the water. The live algae are confined mainly to the illuminated surface waters which extend down to a depth of about twice the Secchi disc reading. The chlorophyll samples were collected by filling the sample bottle as it was lowered and raised from this depth, and were thus representative of the average algal density through this illuminated zone.

[1]Guidelines and Criteria for Water Quality Management in Ontario - MOE, 1974.

DESCRIPTION OF THE JERRY LAKE AREA

Lake and Soil Characteristics

Jerry Lake, a small privately owned lake, is located in Sinclair Township in the District Municipality of Muskoka, approximately 9.5 kilometers (6 miles) east of Huntsville. The only access to the lake is provided by a private road running north of Highways #35 and #60 near the hamlet of Grassmere. The only structure on the lakeshore is one boathouse at the southern end of the lake. Along the north-west shore, land had previously been cleared by logging and some evidence of these operations is still present.

The lake lies within the Precambrian Shield at an elevation of 328 meters (1075 feet) above sea level. The surrounding area is characterized by rolling to steep hills, of which some rise to 84 meters (275 feet) above lake level. The bedrock in the area is a slightly granitized, banded migmatite which is a highly metamorphosed rock of Precambrian age. It is generally a dark grey weathered rock, massive in structure, with some fracturing or cracking occurring along the weathered surface. The bedrock forms steep cliffs along the east shore of the lake which suggests that some local faulting action did occur and that the long direction of the lake follows an old fault trace. Depth soundings along the lake bottom tend to support this observation, as readings in the order of 20 meters were recorded directly offshore from the cliffs in contrast with the more gently sloping lake bottom found in most other inshore areas of the lake. Bedrock is exposed intermittently along a substantial portion of the shore of the lake, and except for the area along the north-east bay, the bedrock is close to the surface under the remainder of the shoreline. In the north-east bay, an extensive deposit of sand, ranging from coarse to fine texture is located in a bedrock depression. These sands are probably outwash particles deposited by glacial meltwaters at the conclusion of the last glaciation. The fault in which Jerry Lake is situated most likely formed part of a glacial meltwater channel through the area and presumably the minor sand beaches along the east shore of the lake were deposited at the same time.

Primarily along the west and south shores of the lake there are deposits of sandy, boulder laden glacial till. Because of the difficulty

in augering or digging holes into this material, its thickness could not be determined; however, the presence of numerous bedrock outcrops suggests that the till deposits are relatively shallow. Some restricted till deposits were noted along the east shore.

The lake has a surface area of 0.55 square kilometers (140 acres) and is "boot-like" in shape with the toe facing east at the north end. The average width is approximately 0.3 kilometers (0.2 miles) with a shoreline length of 4.6 kilometers (2.8 miles). The mean depth of Jerry Lake is 13.6m (45 feet) and the maximum depth is about 35m (115 feet).

Jerry Lake is in the north Muskoka River watershed, which is part of the Georgian Bay Terminal Drainage Basin. The immediate area drained by Jerry Lake is approximately 7 square kilometers (3 square miles). The north and north-east area of the watershed is drained by two tributaries which flow through beaver ponds and then merge just before entering Jerry Lake at the north-east corner of the lake. A second stream enters the lake from the west (Figure 1).

Drainage flows from the south end of Jerry Lake into Peninsula Lake approximately 1.8 kilometers (1.1 miles) to the south and from there through the Muskoka River system of lakes and rivers to Georgian Bay.

RESULTS AND DISCUSSION

Bacteriology

In 1972, Jerry Lake was surveyed in May, in mid-June through July, and again in October. The data from the long survey of June and July were divided into six periods of seven days length for comparison.

In May the geometric mean densities for the major portion of the lake were 44 TC, 2 FC and 2 FS per 100 ml (Group A, Figure 3). The mouth of the northern inflowing stream (Stn. 11) which drained a marsh had higher bacterial densities than the main body of water with values of 1,130 TC, 4 FC, and 21 FS per 100 ml. This very high total coliform density was not accompanied by high densities of fecal bacteria and so many of these bacteria were likely of natural soil origin. The relative densities of fecal streptococcus indicated that the input of fecal bacteria was not of recent origin. Two locations in the western stream (Stns. 18, 19) showed a slightly higher fecal coliform density of 3 FC per 100 ml but this appeared to be small in quantity as the mouth of the stream was not influenced. The bottom waters, monitored by stations 29D, 30D, and 31D had lower total coliform levels of 7 per 100 ml.

In June the first survey showed that the geometric mean densities for the main portion of the lake were 39 TC, 1 FC and 5 FS per 100 ml (Group A, Figure 4). The mid-lake and bottom waters at one location (Stn. 29 and 29D) had lower total coliform densities of 11 per 100 ml. The mouth of the northern inflowing stream (Stn. 11) was again of poorer water quality with densities of 817 TC, 7 FC, and 59 FS per 100 ml. A location (Stn. 12) near the mouth of this stream had a higher total coliform density of 121 per 100 ml, and a small bay to the east of the stream mouth had higher coliform levels of 39 TC and 7 FC per 100 ml. One location in the western inflowing stream (Stn. 19) had higher bacterial densities than the main body of water with levels of 353 TC, 2 FC, and 79 FS per 100 ml, but the quantity of bacteria appeared to be small for, as in May, the stream mouth was not influenced. However, a shoreline location to the south of this stream had poorer water quality with 138 TC and 3 FC per 100 ml. This pattern of bacterial distribution with only minor variations

was maintained throughout the other summer surveys (Figures 5, 6, 7, 8, 9) and the October survey (Fig. 10).

This consistent pattern of bacterial distribution can be summarized briefly as follows. The bacterial densities in the main portion of the lake were very low and fecal coliforms frequently could not be isolated. Bacterial densities in the inflowing streams were always much higher than the main body of water and one or all of the parameters would exceed the Recreational Criteria[2] (Figures 3, 4, 5, 6, 7, 8, 9, 10). The mouth of the larger stream in the north (Stns. 11, 12) was normally influenced by the inflow of bacteria (Figures 3, 4, 5. 6, 7, 8, 9, 10) but the mouth of the smaller stream flowing into the lake from the west was influenced only once by the upstream bacteria and this was taken as proof that the quantity of bacteria flowing from the stream into the lake was small (Figure 9). Mid-lake surface and bottom waters were frequently lower in bacterial densities than the inshore areas of the lake (Figures 4, 8, 9, 10). On only one occasion was the mouth of the outflowing stream higher than the main portion of the lake (Figure 7). This phenomenon has occurred on other lakes surveyed by the MOE but is poorly understood at present.

The survey periods were also compared by calculating the geometric mean bacterial densities for periods of time other than the seven consecutive days used initially as survey periods. The effect of choosing one survey time rather than another could be seen, for the new times overlapped with the original survey periods (Table 1). On some occasions the differences were quite large, as when the survey period June 30 - July 6 was compared with July 1 - July 5 (Table 1). Other differences were not as large. The choice of survey time was concluded to have a measurable effect on the final results but not sufficiently to significantly alter the interpretation of the data.

The seasonal distribution of bacterial densities in the main part of the lake for all surveys are shown in Figure 11. Total coliform levels were fairly stable throughout the year whereas fecal streptococcus levels,

[2]Guidelines and Criteria for Water Quality Management in Ontario - MOE 1973.

which were stable in June, rose steadily thereafter, and reached a peak on July 23. Fecal streptococcus and fecal coliforms were isolated infrequently in October. Fecal coliform levels were very low throughout the surveys with two very small peaks observed at the end of June and July (Figure 11).

The bacterial densities at the mouth of the northern stream, and to a lesser extent in the western inflowing stream itself, were unexpectedly high. The data for the northern stream mouth (Stn. 11) show that the bacterial densities at the stream mouth were 100 x that of the main body of the lake (Figure 12). The fecal coliform level at this stream mouth location rose throughout the summer survey to a value in excess of the Recreational Criteria which states

> Where ingestion is probable, recreational waters can be considered impaired when the coliform (TC), fecal coliform (FC) and/or enterococcus (fecal streptococcus, FS) geometric mean density exceeds 1000, 100 and/or 20 per 100 ml respectively, in a series of at least ten samples per month, ----2.

The stream was weedy, narrow, and not of recreational importance. The fecal coliform-to-fecal streptococcus ratio was usually less than 1.0 and this indicated that these fecal bacteria were probably of animal or stormwater origin. The watershed of the stream was undeveloped for human use and so human contamination was unlikely.

In 1973, three further surveys were carried out in May, July and Sept. The bacteriological water quality of Jerry Lake in 1973 was excellent with the one exception of the mouth of the northern inflowing stream.

In May, the geometric mean densities for the major portion of the lake were 8 TC, 1 FC and 2 FS per 100 ml (Group A, Figure 13). Bacterial levels higher than these were found at only two locations; the western inflowing stream with means of 33 TC and 13 FS per 100 ml (Group B, Figure 3), and the mouth of the northern stream which enters the lake as three small channels which were all monitored separately. Bacterial levels of 118 TC, 8 FC and 24 FS per 100 ml were found at the most westerly of these inflowing channels (Stn. 36). The total coliform density at the central channel (Stn. 12) was 46 TC per 100 ml, while the bacterial levels

at the eastern inflowing channel (Stn. 11) were 145 TC, 3 FC and 2 FS per 100 ml. Inflowing streams often carry high bacterial loads as they may wash materials such as soil, decaying matter and possibly animal wastes into lakes. This pattern of distribution of bacteria in Jerry Lake's streams was maintained in the July and September surveys of 1973 as well (Figure 14 and 15).

The main portion of Jerry Lake had excellent bacteriological water quality in all three surveys in 1973. The bacterial levels rose during the summer, but not excessively, and fell again in the fall (Figure 16). Fecal coliform levels were very low in all three surveys. Elevated levels of bacteria were found in the inflowing streams, and the fecal streptococcus levels, particularly in July and September, consistently exceeded the Recreational Use Criteria cited above.

It has often been observed that following a rainfall, bacterial levels increase in some cottaged lakes and may remain elevated for a number of days. To demonstrate this "rainfall effect" in Jerry Lake, daily geometric mean fecal streptococcus densities were calculated and plotted with the quantity of rain for each day, measured at the Huntsville Sewage Treatment Plant. An increase in density of fecal streptococcus was noted after rainfall on July 26th (Figure 17). It should be noted that this is only a small rainfall effect and that fecal coliform densities did not increase to the same extent as on some other similar, but cottaged recreational lakes in Ontario.

The bacterial densities in the main body of the lake in 1972 and 1973 were compared in table 2. The densities were a little higher in 1972 than in 1973 but the differences were not large. Much higher densities of bacteria were found in the inflowing streams in 1972 and this was attributed to the higher rainfall that summer, and it was likely that the higher bacterial densities in the main body of water in 1972 was also a result of higher rainfall.

Intensive bacteriological studies on undeveloped lakes are few in number. Based on the Jerry Lake study, the following general observations may be made for bacterial types and densities in a Precambrian lake under

nearly natural conditions. High densities of indicator bacteria are not found in the main body of such lakes, but may be observed in the inflowing streams and provide evidence for small quantities of animal or storm water pollution. As expected, evidence of human contamination is absent. Seasonal and yearly variations in bacterial densities are small.

TABLE 1

Bacterial Densities per 100 ml in the Main Portion of Jerry Lake in 1972

DATE OF SURVEY	FIGURE	TC	Group A FC	FS
May 21 - 25	3	44	2	2
June 16 - 20	-	25	1	4
June 16 - 22	4	39	1	5
June 21 - 25	-	77	1	4
June 23 - 29	5	72	1	3
June 26 - 30	-	63	2	3
June 30 - July 6	6	80	1	4
July 1 - 5	-	38	1	3
July 6 - 10	-	41	1	7
July 7 - 13	7	51	1	7
July 11 - 15	-	49	1	9
July 14 - 20	8	49	1	17
July 16 - 20	-	43	1	18
July 14 - 22	-	68	1	20
July 21 - 25	-	62	3	33
July 21 - 27	-	56	4	28
July 23 - 30	9	55	3	10
Oct. 17 - 21	10	51	1	1

TABLE 2

Bacterial Densities per 100 ml in the Main Body of Jerry Lake

Survey Date	1972			1973		
	TC	FC	FS	TC	FC	FS
May 21 - 25	44	2	2	-	-	-
May 23 - June 2	-	-	-	8	1	2
July 26 - 30	38	1	6	-	-	-
July 24 - Aug 3	-	-	-	51	1	6
Sept. 10 - 15	-	-	-	11	1	2
Oct 17 - 21	51	1	1	-	-	-

FIGURE 3 – DISTRIBUTION OF BACTERIA FOR THE MAY 21-25 SURVEY, 1972

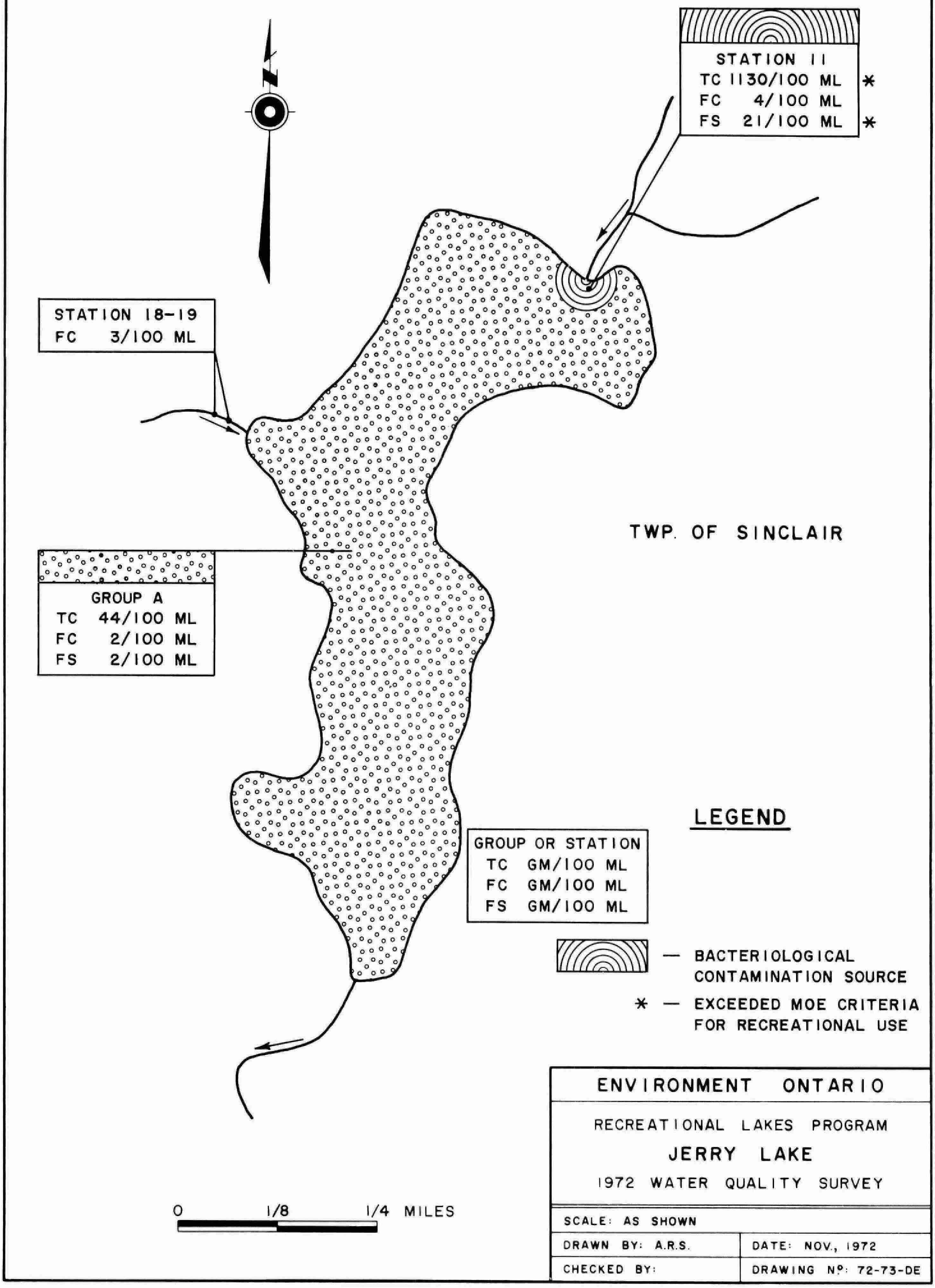
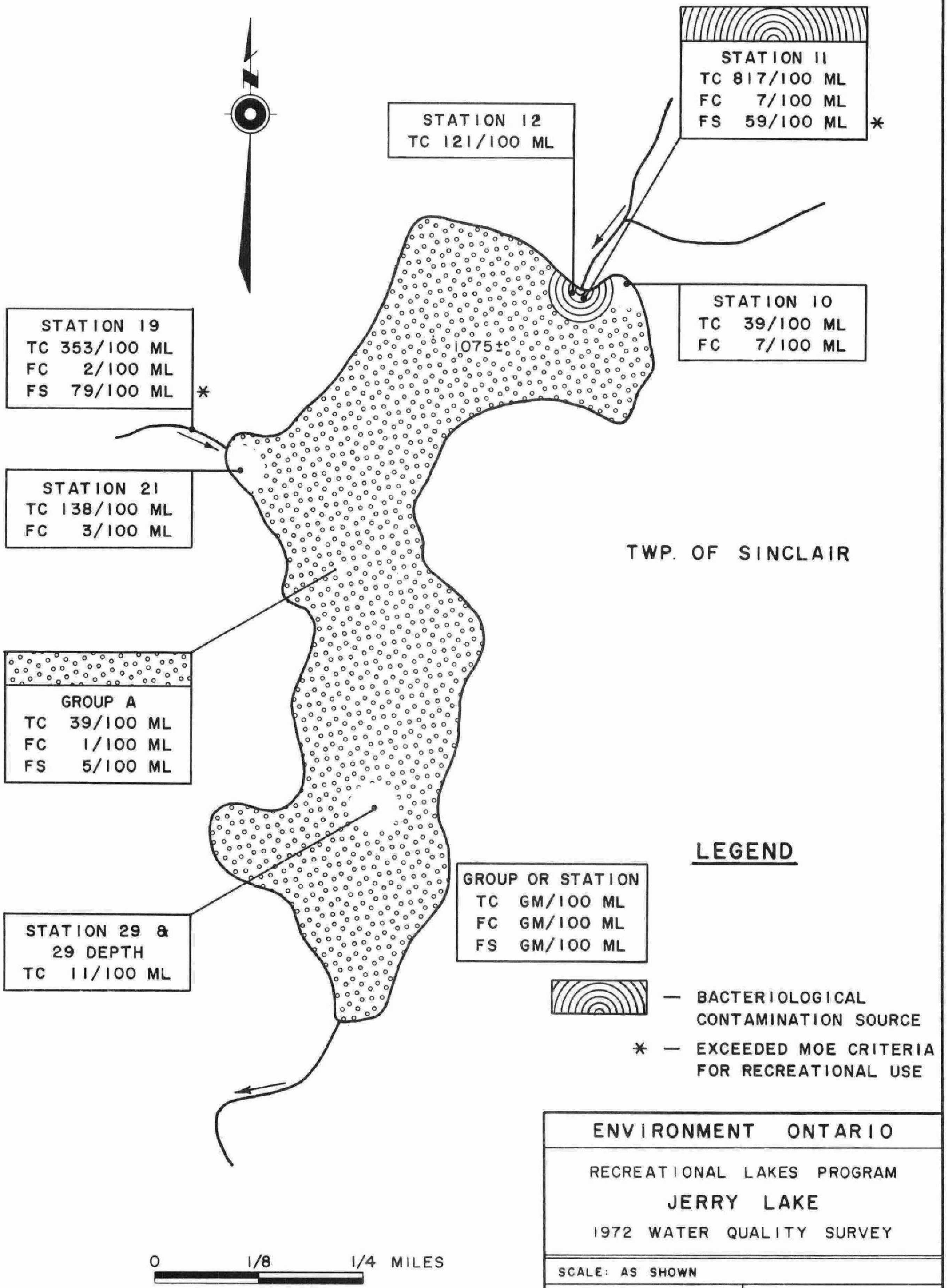


FIGURE 4 – DISTRIBUTION OF BACTERIA FOR THE JUNE 16–22 SURVEY, 1972



ENVIRONMENT ONTARIO

RECREATIONAL LAKES PROGRAM

JERRY LAKE

1972 WATER QUALITY SURVEY

SCALE: AS SHOWN	
DRAWN BY: A.R.S.	DATE: NOV., 1972
CHECKED BY:	DRAWING Nº: 72-73-DE

FIGURE 5 - DISTRIBUTION OF BACTERIA FOR THE JUNE 23-29 SURVEY, 1972

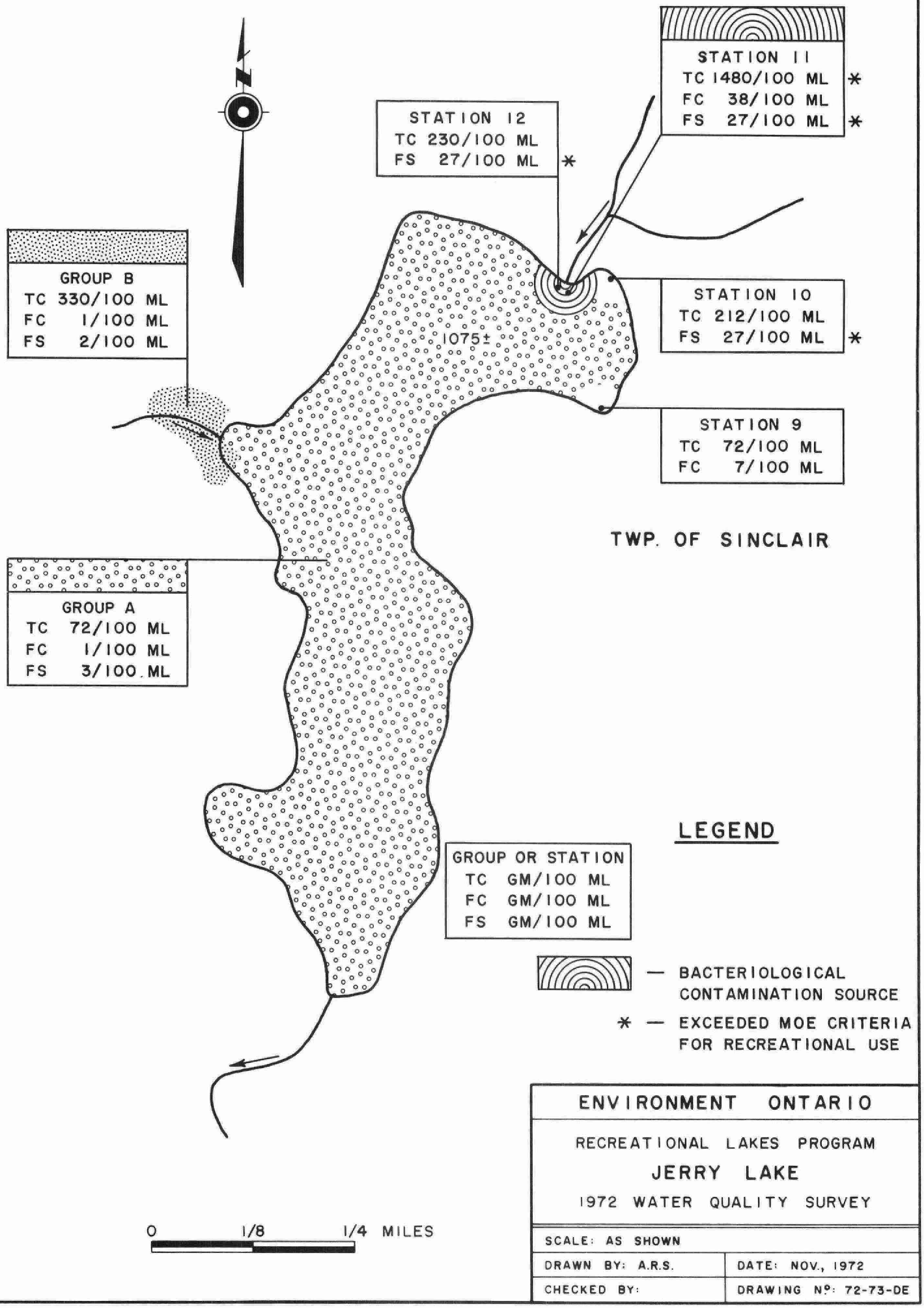


FIGURE 6 - DISTRIBUTION OF BACTERIA FOR THE JUNE 30 - JULY 6 SURVEY, 1972

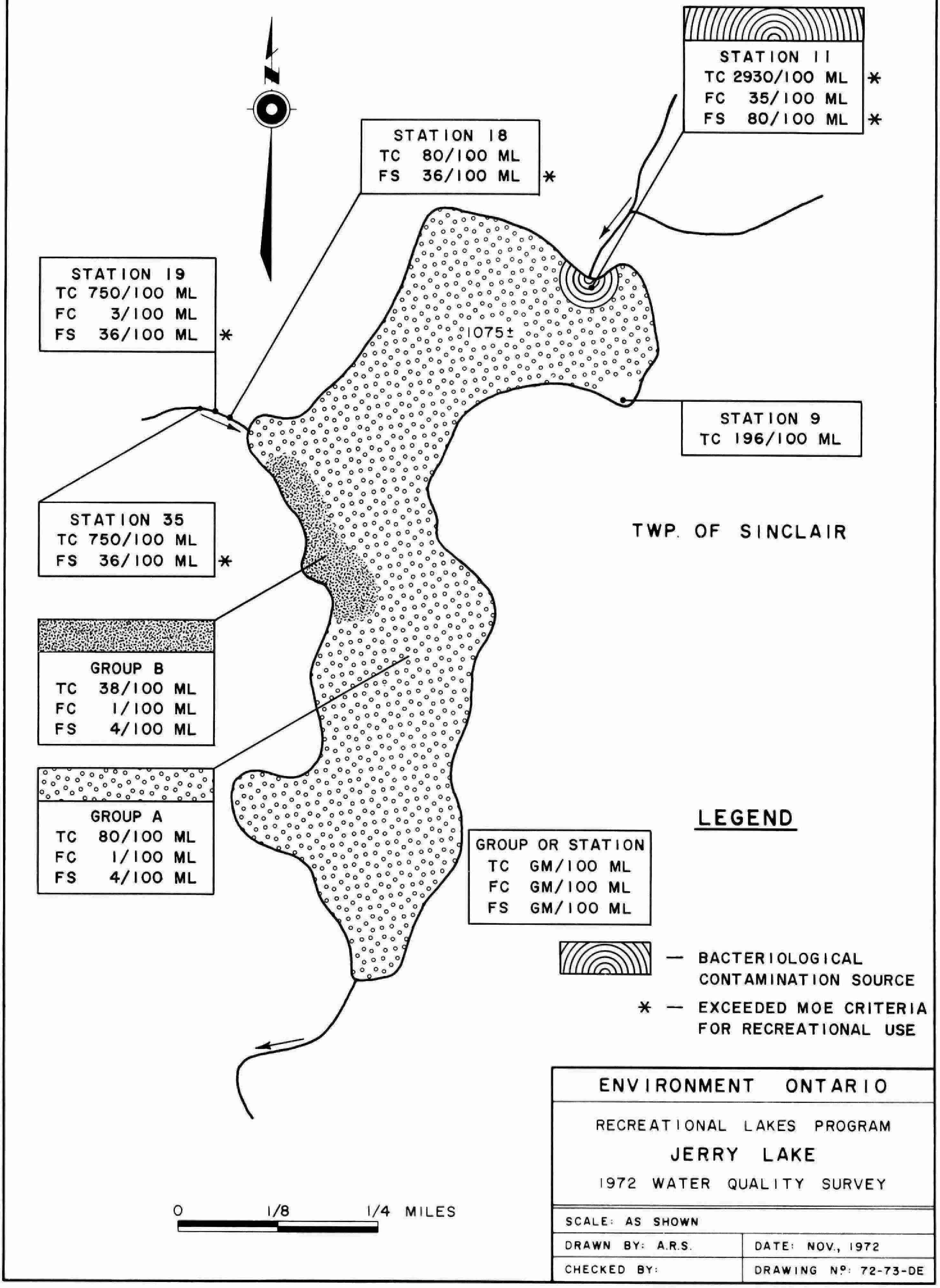


FIGURE 7 - DISTRIBUTION OF BACTERIA FOR THE JULY 7-13 SURVEY, 1972

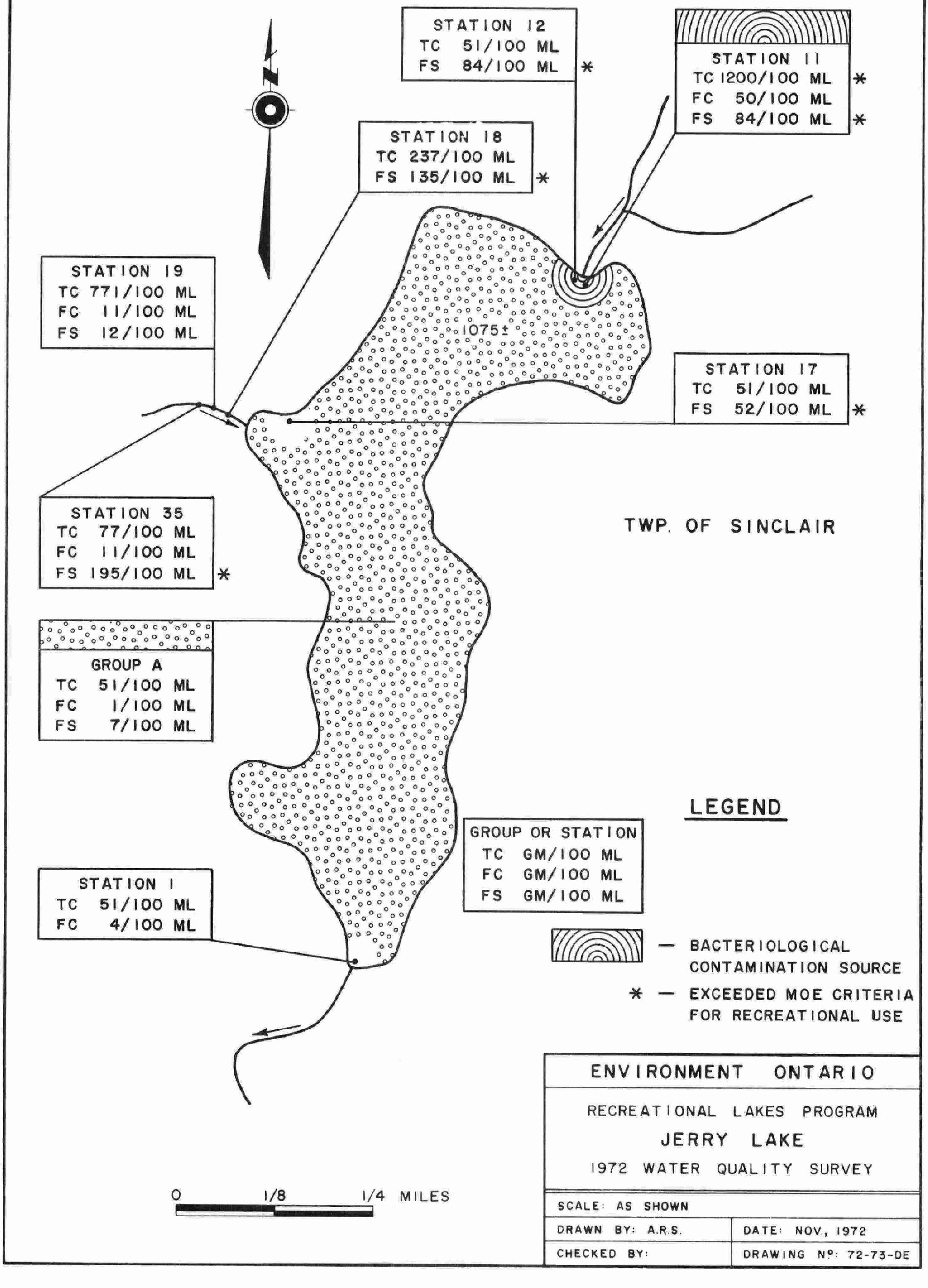


FIGURE 8 – DISTRIBUTION OF BACTERIA FOR THE JULY 14-20 SURVEY, 1972

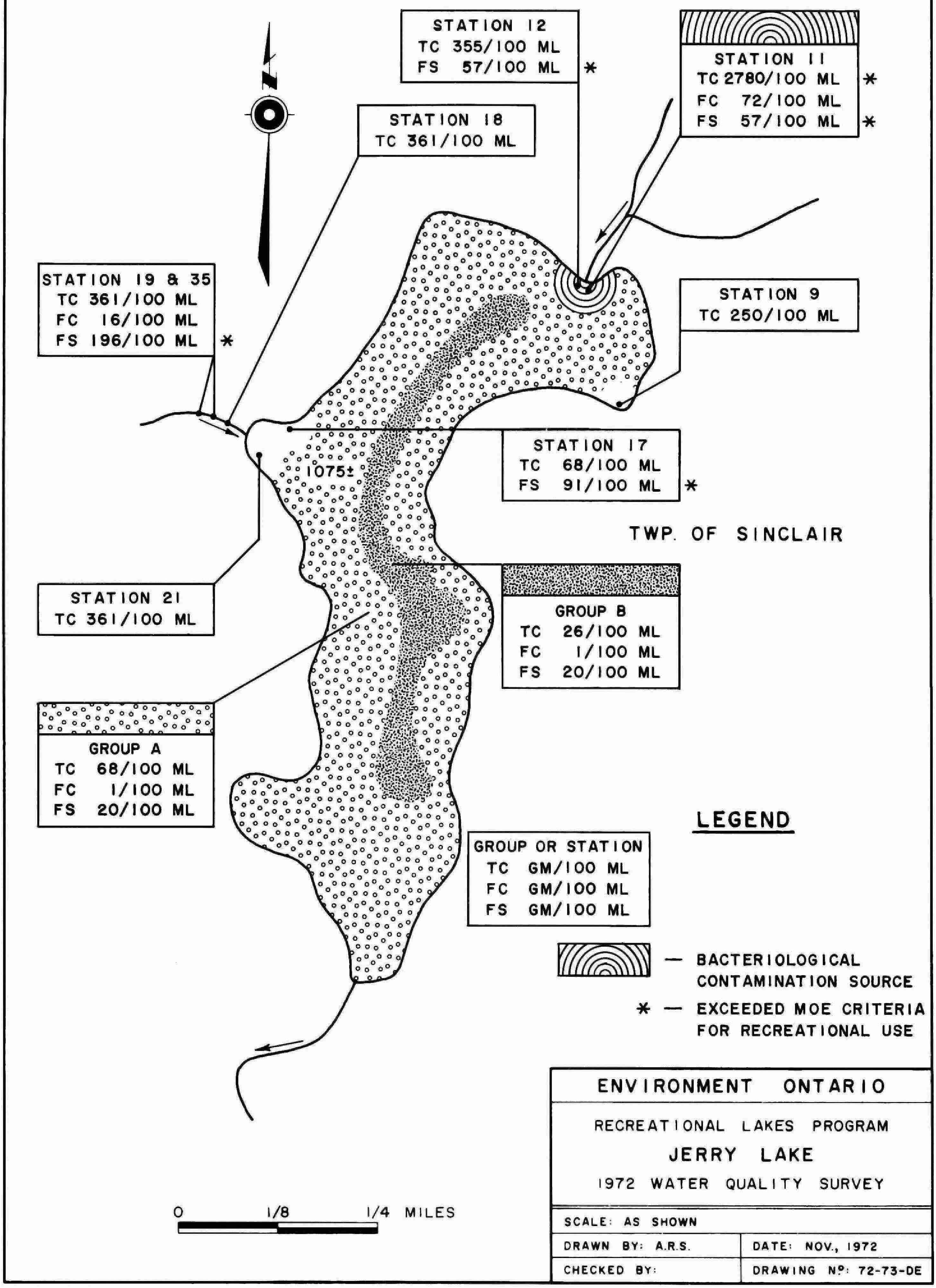


FIGURE 9 – DISTRIBUTION OF BACTERIA FOR THE JULY 23-30 SURVEY, 1972

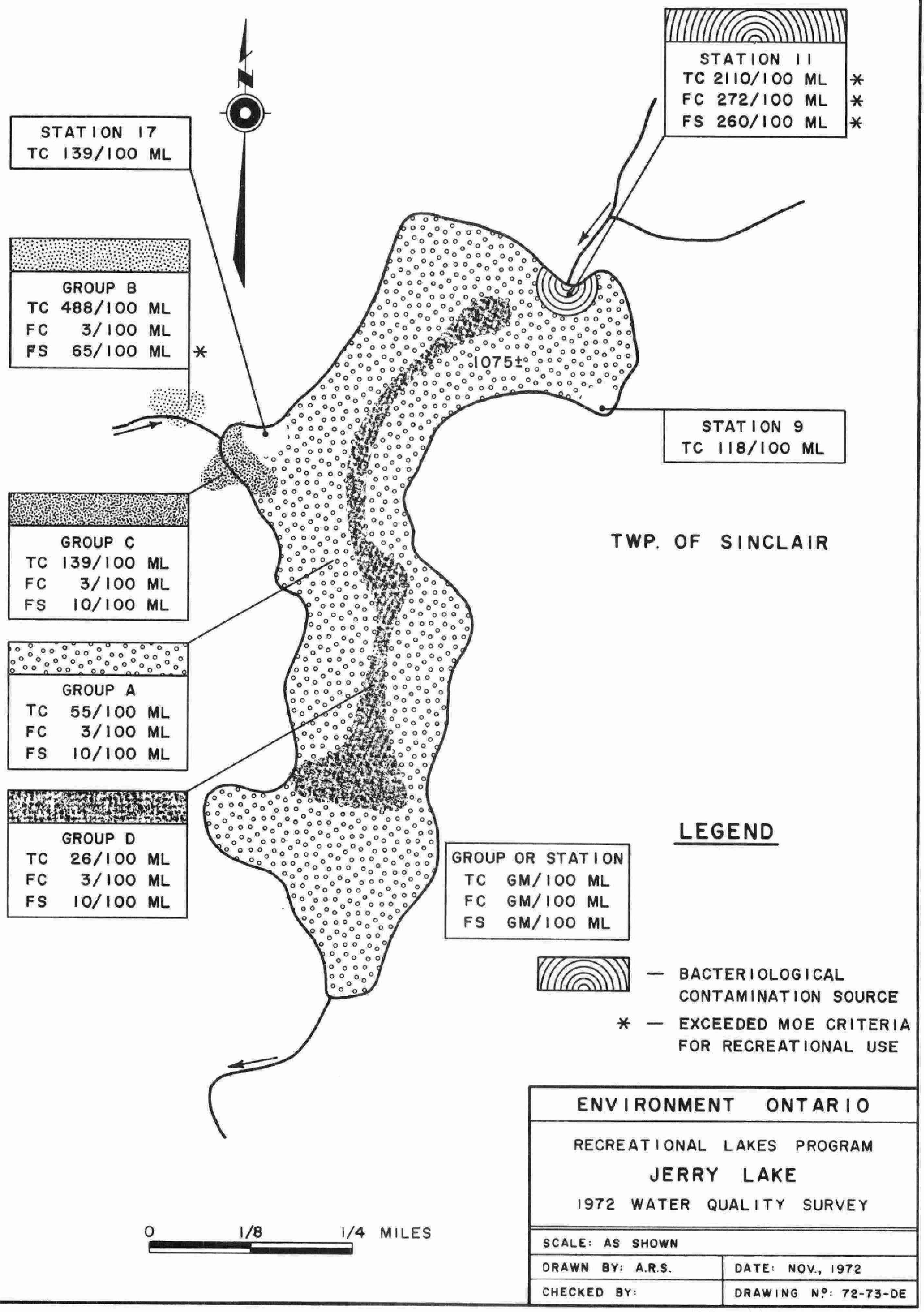


FIGURE 10 - DISTRIBUTION OF BACTERIA FOR THE OCT. 17-21 SURVEY, 1972

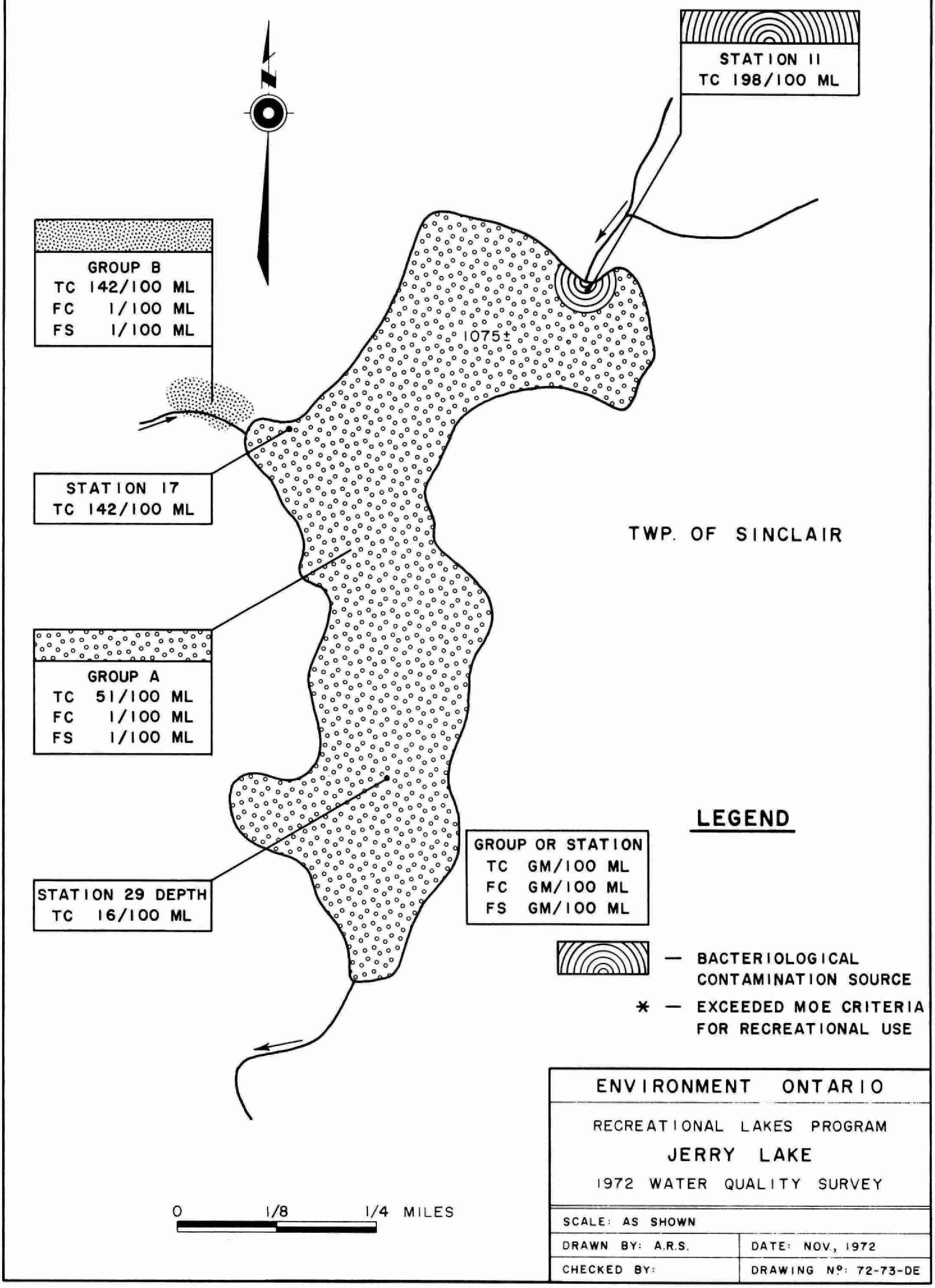


FIGURE II - BACTERIAL DENSITIES IN THE MAIN BODY OF JERRY LAKE IN 1972

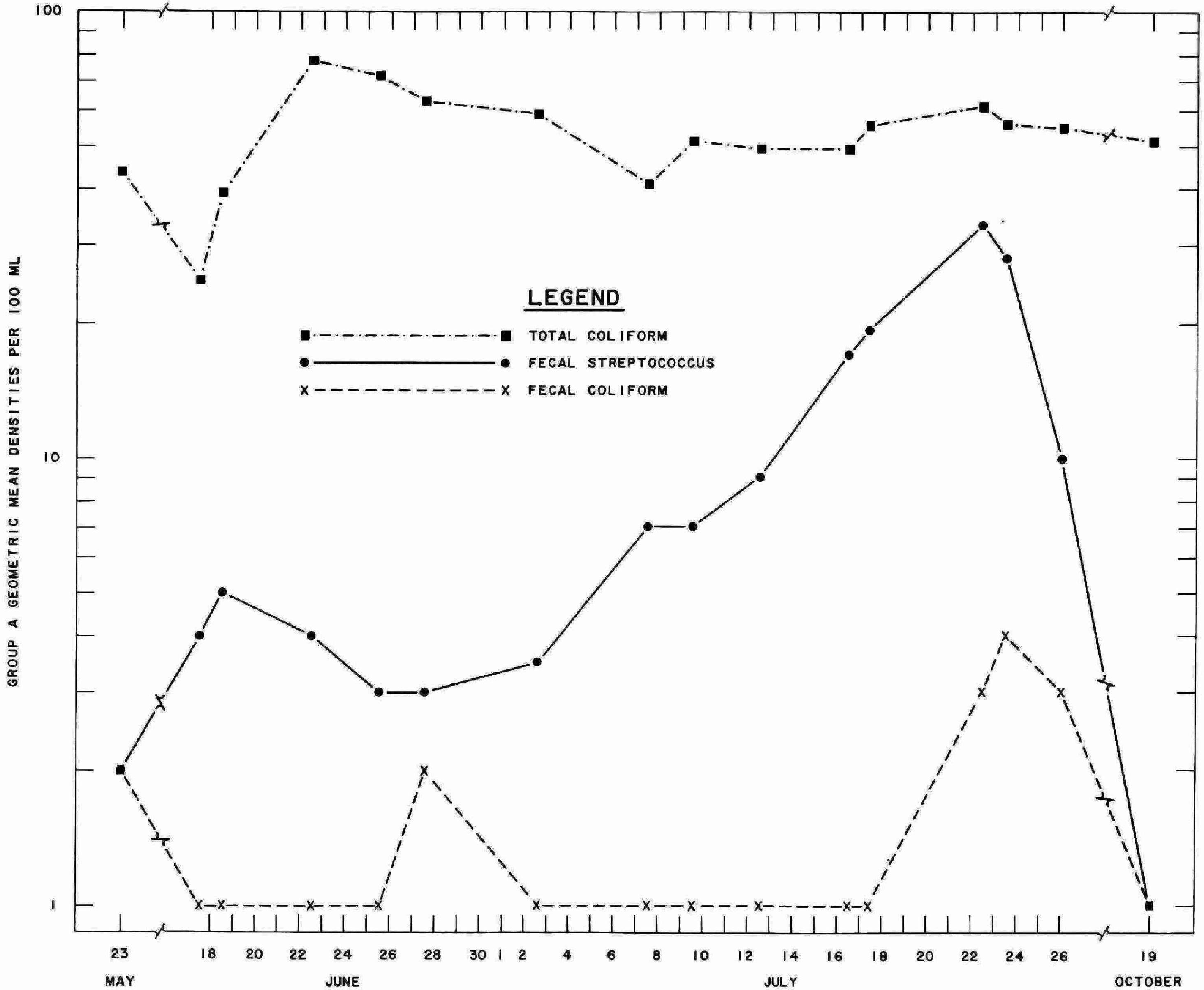


FIGURE 12 - BACTERIAL LEVELS AT THE NORTHERN STREAM MOUTH OF JERRY LAKE IN 1972

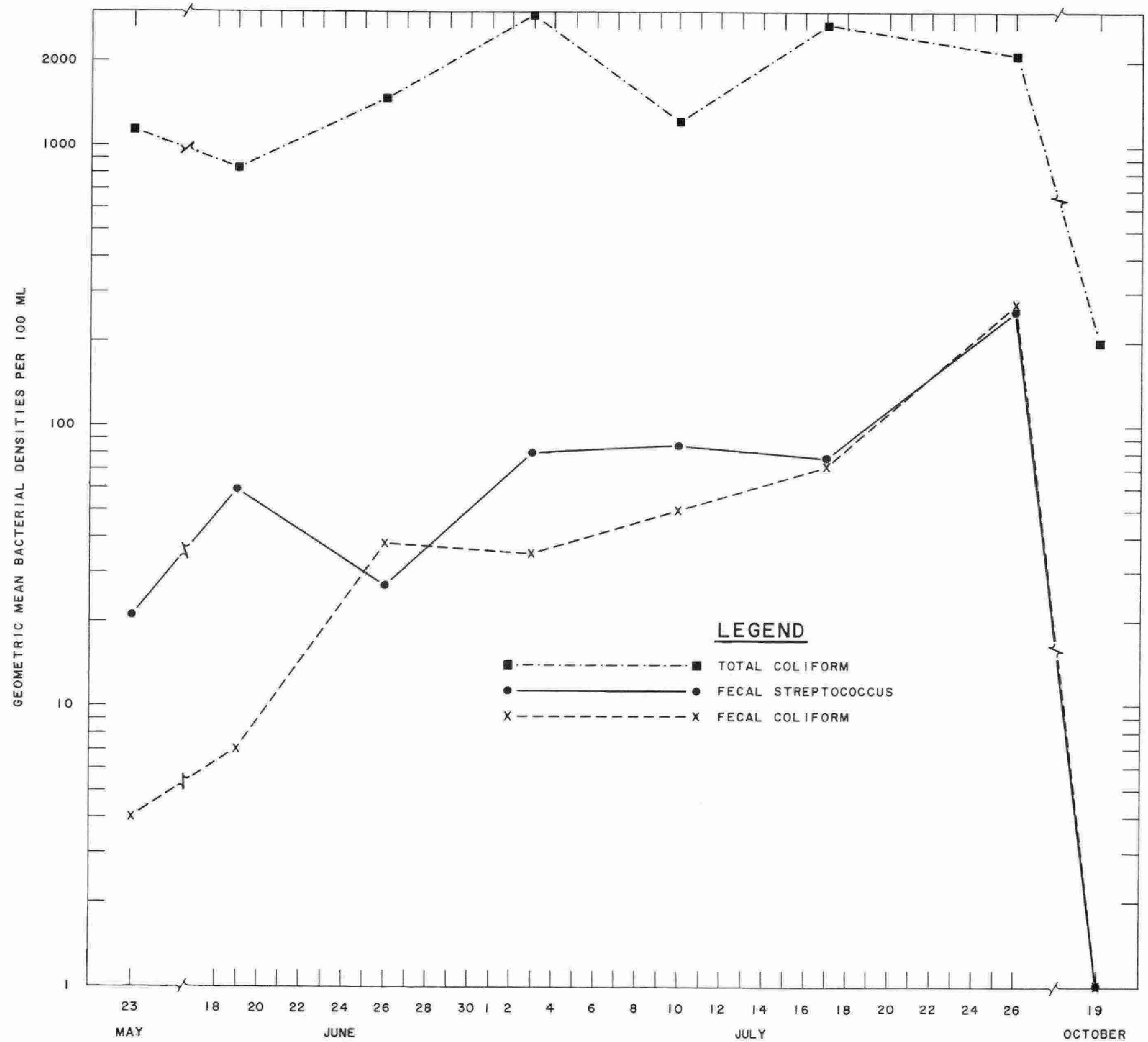


FIGURE 13 - DISTRIBUTION OF BACTERIA FOR THE MAY 23 - JUNE 2 SURVEY, 1973

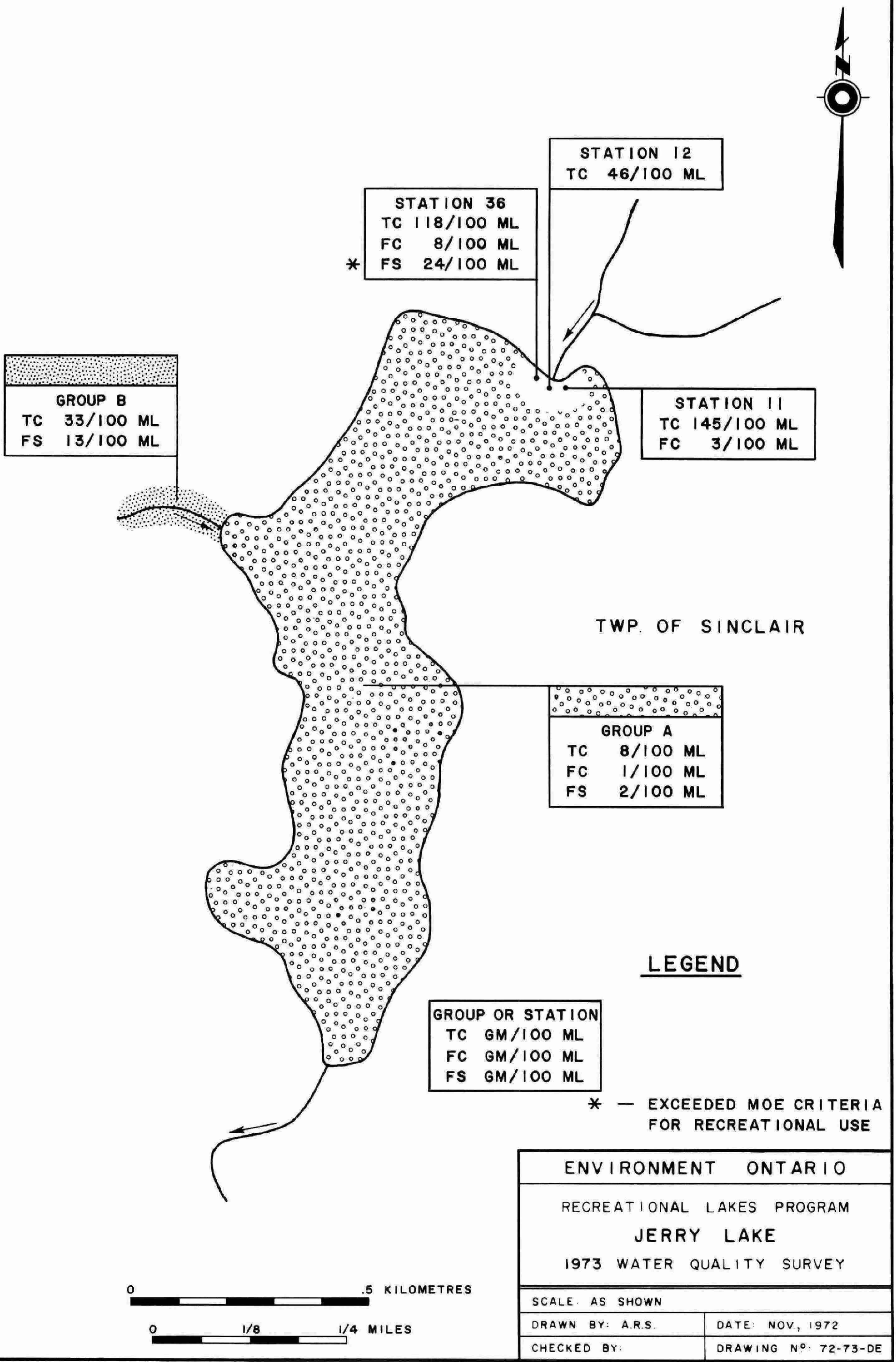


FIGURE 14 - DISTRIBUTION OF BACTERIA FOR THE JULY 24 - AUGUST 3 SURVEY, 1973

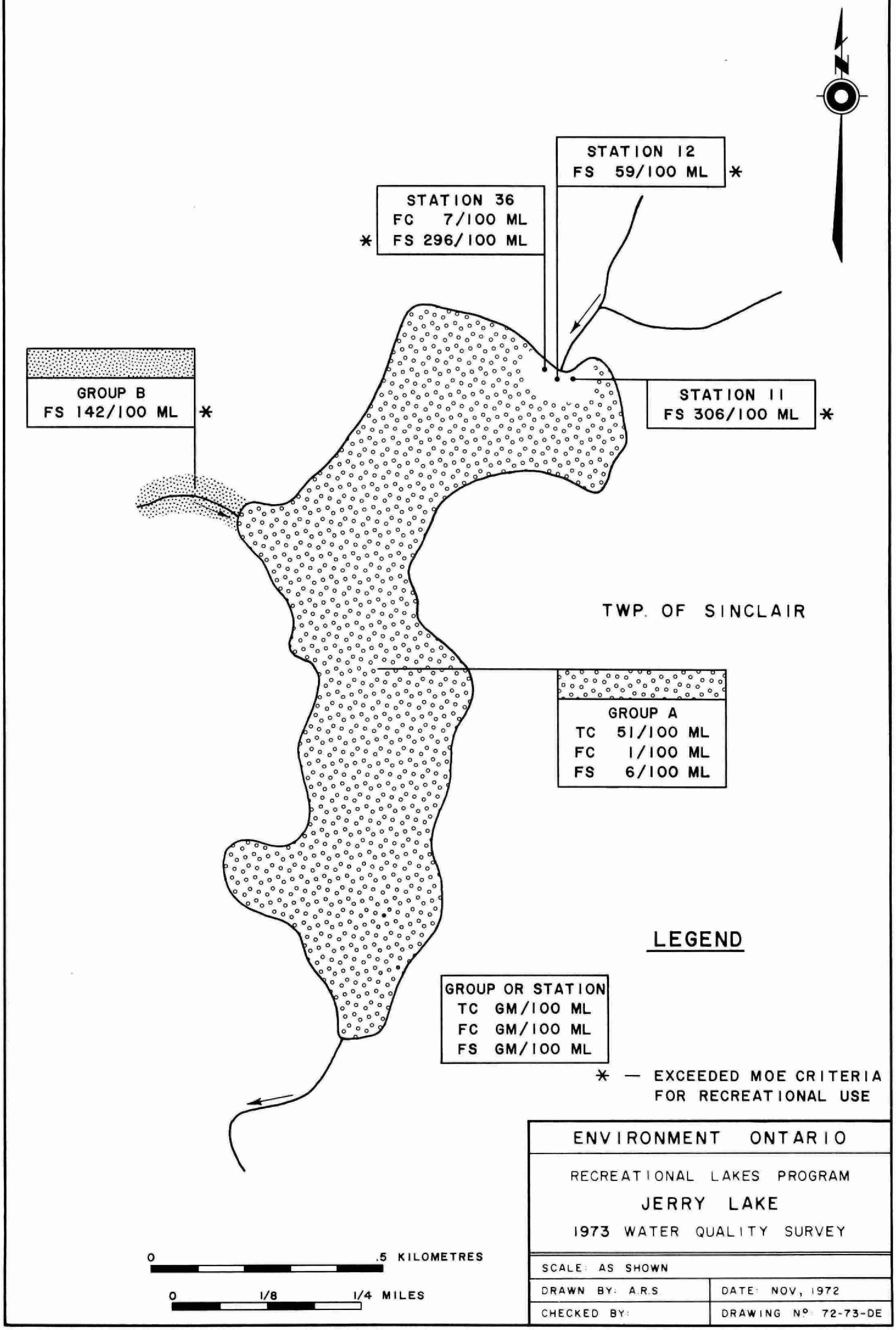
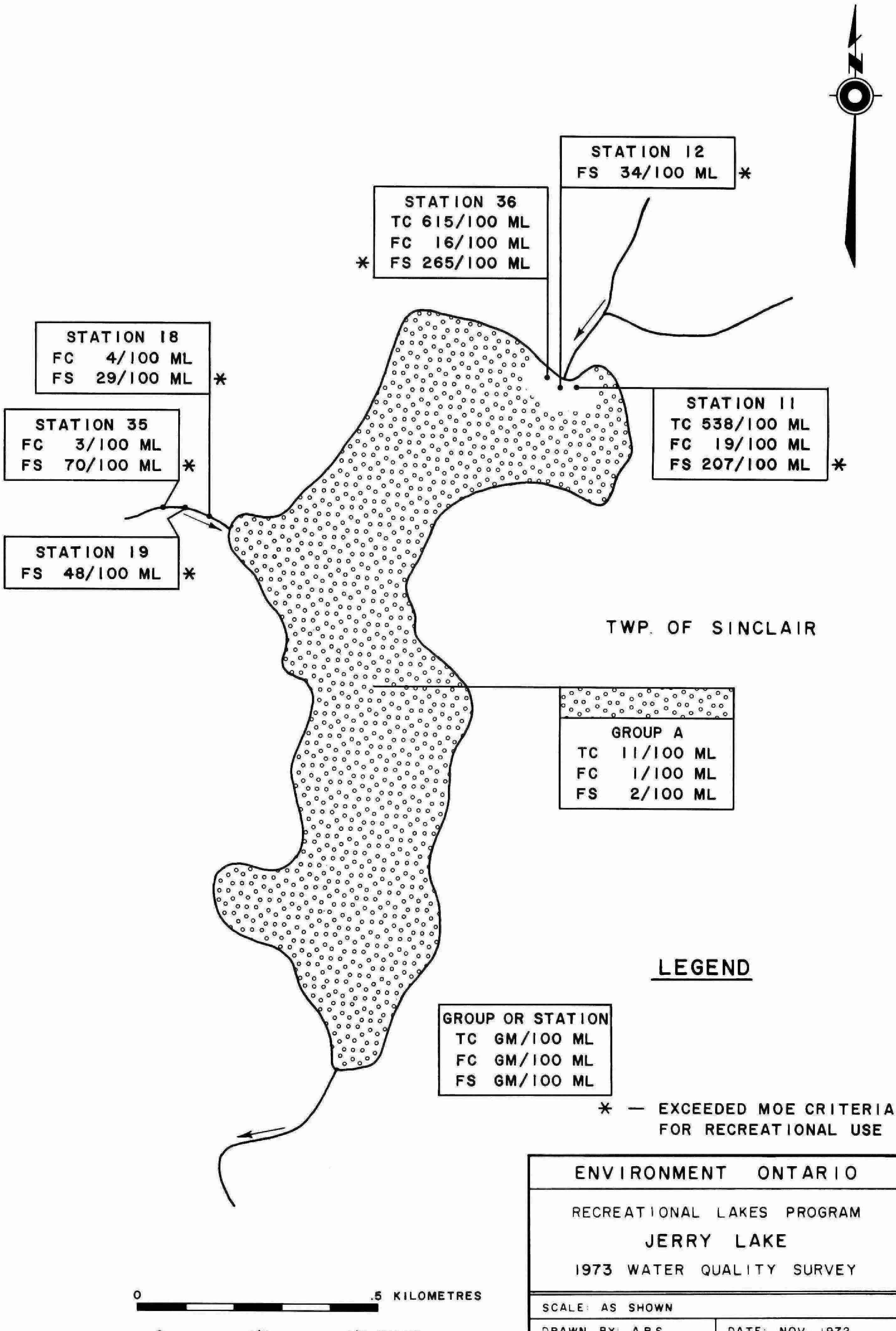


FIGURE 15 - DISTRIBUTION OF BACTERIA FOR THE SEPTEMBER 10-15 SURVEY, 1973



ENVIRONMENT ONTARIO	
RECREATIONAL LAKES PROGRAM JERRY LAKE 1973 WATER QUALITY SURVEY	
SCALE: AS SHOWN	
DRAWN BY: A.R.S.	DATE: NOV, 1972
CHECKED BY:	DRAWING Nº: 72-73-DE

FIGURE 16 - COMPARISON OF THREE SURVEYS OF BACTERIAL DENSITIES FOR THE MAIN BODY OF JERRY LAKE

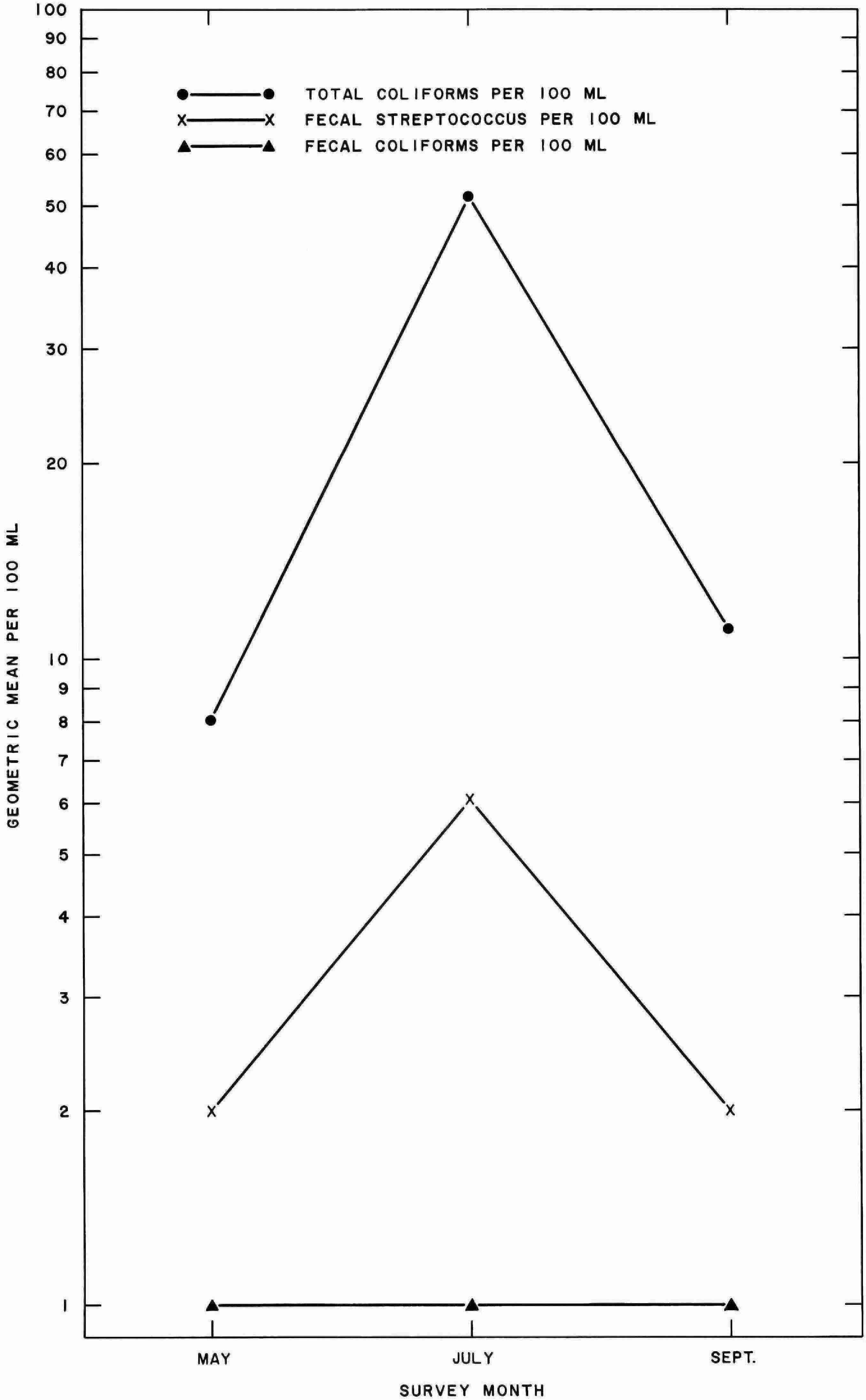
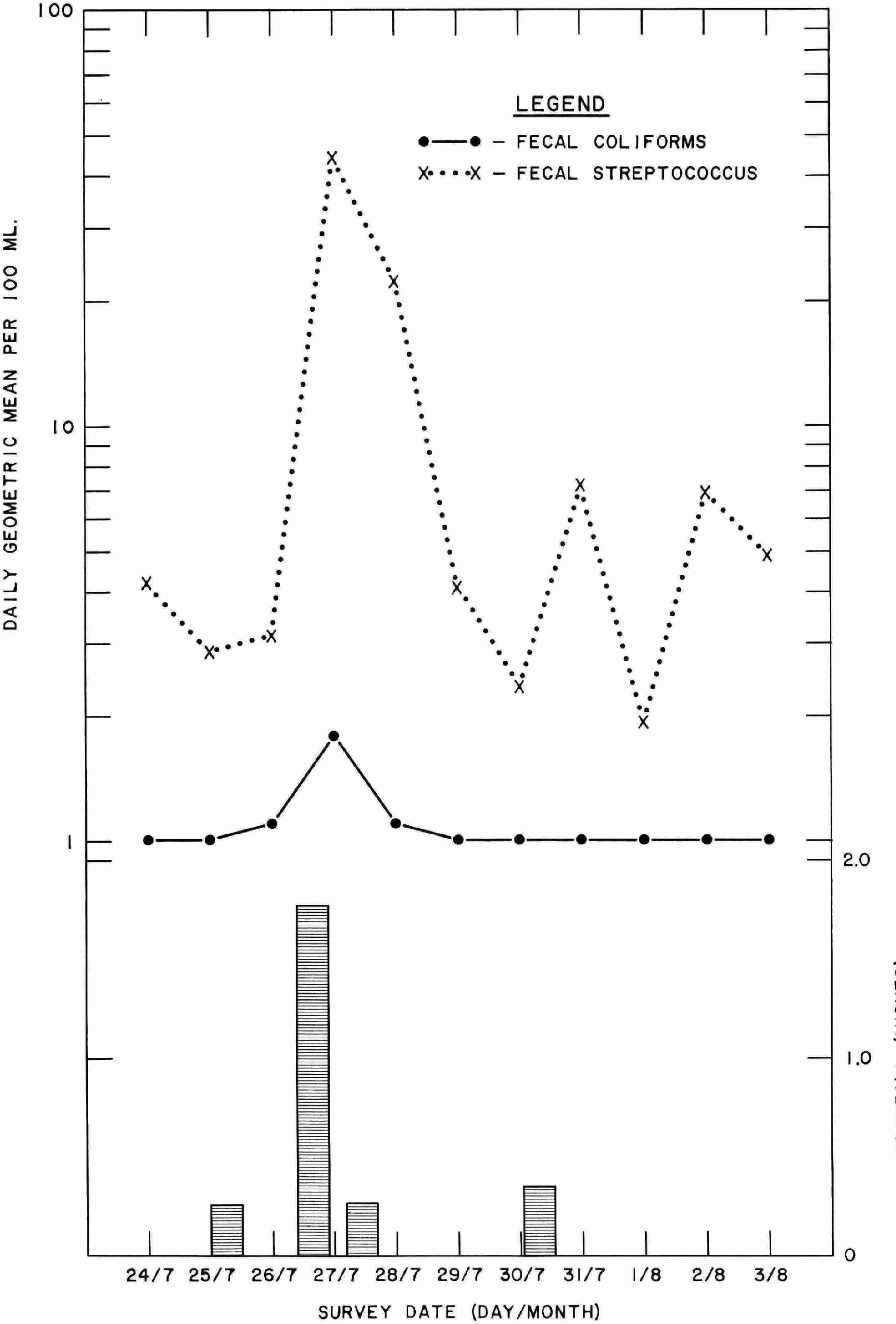


FIGURE 17 – RAINFALL EFFECT ON JERRY LAKE IN JULY 1973



Temperature and Dissolved Oxygen

During both 1972 and 1973, the surface waters of Jerry Lake had warmed sufficiently by late May that a well established zone of rapidly decreasing temperatures (thermocline) was evident (Figure 18). Maximum surface water temperatures ranging between 20 and 24°C were recorded during July and August (Figure 18), while temperatures below 15-20m were maintained at about 4°C throughout the ice-free period.

Surface water dissolved oxygen concentrations were frequently at or above 100% of saturation; however, bottom water amounts decreased throughout the ice-free period until by late October, saturations below 10% were found below 15m. The surface waters had cooled to the extent that the lake became well mixed and homothermous (3°C) by early December. Dissolved oxygen was replenished at this time also and values near 80% of saturation were found from surface to bottom about one week before formation of winter ice cover.

Dissolved oxygen depletion in Jerry Lake under winter ice was much less severe than during the ice-free period with lowest amounts (35% of saturation) found in early April in the near-bottom waters.

Mineral and Nutrient Characteristics

Jerry Lake, typical of most other lakes on the Precambrian Shield, is characterized by soft waters of low mineral and nutrient content (Table 3).

Table 3: Mineral and nutrient characteristics of the surface waters of Jerry Lake during the ice-free period.

	Mean	Range
Specific Cond. (25°C; μmhos/cm)	38	36 - 53
Alkalinity (mg/l $CaCO_3$)	7	4 - 14
Hardness (mg/l $CaCO_3$)	17	12 - 26
pH	6.6	6.1 - 7.0
Total Iron (mg/l)	0.19	0.05- 1.8
Chloride (mg/l)	<1	<1 - 3
Sulphate (mg/l)	10	9 - 14
Total phosphorus (μg/l)	16	7 - 46
Ammonia-nitrogen (μg/l)	40	<10 - 100
Nitrate-nitrogen (μg/l)	40	<10 - 80
Total Kjeldahl-nitrogen (μg/l)	300	250 - 400

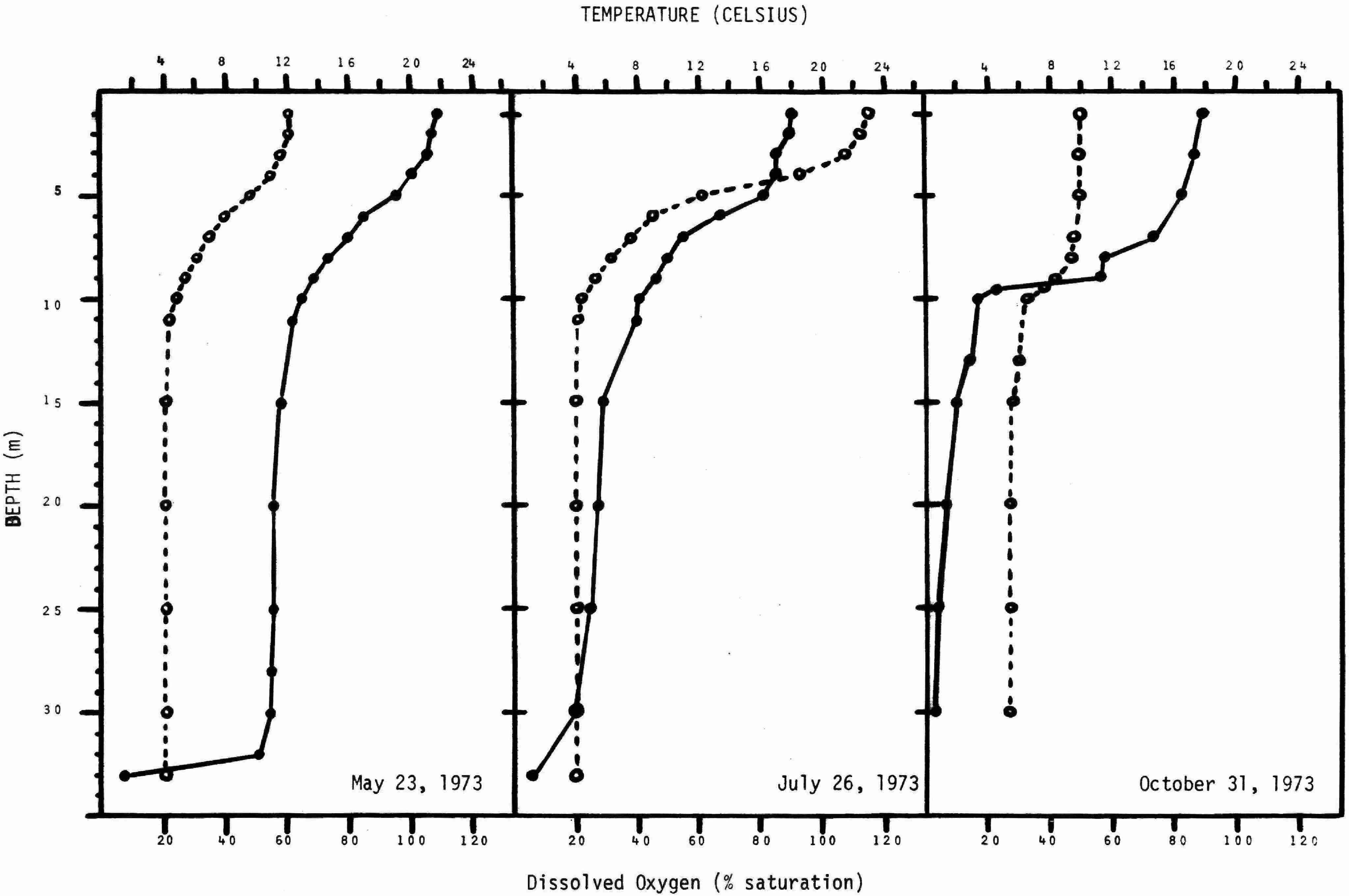


Figure 18 : Dissolved oxygen (•——•) and temperature (o-----o) profiles on three selected dates, in Jerry Lake, 1973.

Mineral characteristics of the inflowing and outflowing streams differed little from the open lake, although bottom water conductivity, alkalinity and hardness values were slightly higher and accompanied slightly lower pH values than found in surface waters, especially during late summer.

Considerable accumulation of iron (as high as 3.2 mg/l) was found in the near bottom waters by October accompanying the very low dissolved oxygen concentrations. Iron concentrations were relatively high in the major inflowing stream (Station 11), averaging 0.77 mg/l during the ice-free period.

Concentrations of phosphorus exceeding 15 μg/l were not uncommon in the surface waters of Jerry Lake during the ice-free period. A maximum concentration of 46 μg/l recorded on July 28 of 1973 was likely the result of rainfall induced runoff following approximately 5 cm of rainfall during the previous two days (P concentrations in the inflowing stream at this time reach 170 μg/l). Somewhat high concentrations of total P were found in the bottom waters during September and October (averaging 34 μg P/l) compared with a June, July and August mean of 22 μg P/l.

Concentrations of total P in the main inflowing stream were far greater than those in the outflow, especially during the low flow period of July, August and September when total phosphorus concentrations exceeded 100 μg P/l on several occasions. Much of the P was probably of dissolved organic origin since the stream water at this time was very clear but highly coloured (100-175 Hazen Units). Concentrations in the 10-30 μg/l range in the inflow characterized the peak flow periods of spring and fall.

Concentrations of inorganic nitrogen were highest (740 μg N/l) in the main inflow during late winter and early spring and lowest (<10 μg N/l) during October and November with nitrate -N concentrations somewhat greater than ammonia -N concentrations. Despite depletion of bottom water dissolved oxygen by late summer, no accumulations of either nitrate -N or ammonia -N were observed. As in the inflowing stream, nitrate -N levels (60-430 μg N/l) in the bottom waters were greater than those of ammonia - N (<10-130).

Total Kjeldahl-nitrogen concentrations were about twice as high in the inflowing stream as in the outflow, or bottom waters of the lake where mean values and ranges were similar to those found in the surface waters (Table 1). A more detailed treatment of nutrient and plankton dynamics in Jerry Lake and nearby cottaged Harp Lake has been prepared[1].

Chlorophyll a and Water Clarity

As indicated by chlorophyll a concentrations, Jerry Lake was characterized by moderately low densities of suspended algae. Chlorophyll a concentrations were highest during early summer (maximum of 5.6 μg/l) and declined throughout the summer to concentrations less than 0.5 μg/l in September. The average for the ice-free period was 2.6 μg/l. Secchi disc visibility in the lake ranged from a minimum of 2.6m in early summer to a maximum of 6m in late July and averaged 3.9m over the ice-free period.

Lakes exhibit their symptoms of enrichment in several ways (see p.A-6 for an explanation of the relationships between nutrient enrichment, lake water clarity and abundance of suspended algae). A curve relating chlorophyll a and Secchi disc values was derived by staff of the Ministry of the Environment and illustrates the status of enrichment of Jerry Lake relative to other well known Ontario Lakes (Figure 19; see also p.A-6).

Aquatic Plants

Aquatic plant growth in Jerry Lake was sparse with 99% of the shoreline free from plant growth. Thirteen different genera were identified from four shoreline areas of the lake (Figure 20 and Table 4). Many of the plants could only be identified to genus because of the lack of fruiting or flowering structures.

[1]Footnote: *Nicholls, K.H. 1976. Comparative limnology of Harp and Jerry Lakes - adjacent cottaged and uncottaged lakes in southern Ontario's Precambrian Shield. Ontario Ministry of the Environment, Water Resources Branch, Toronto, Ontario. 76p. + Appendices.*

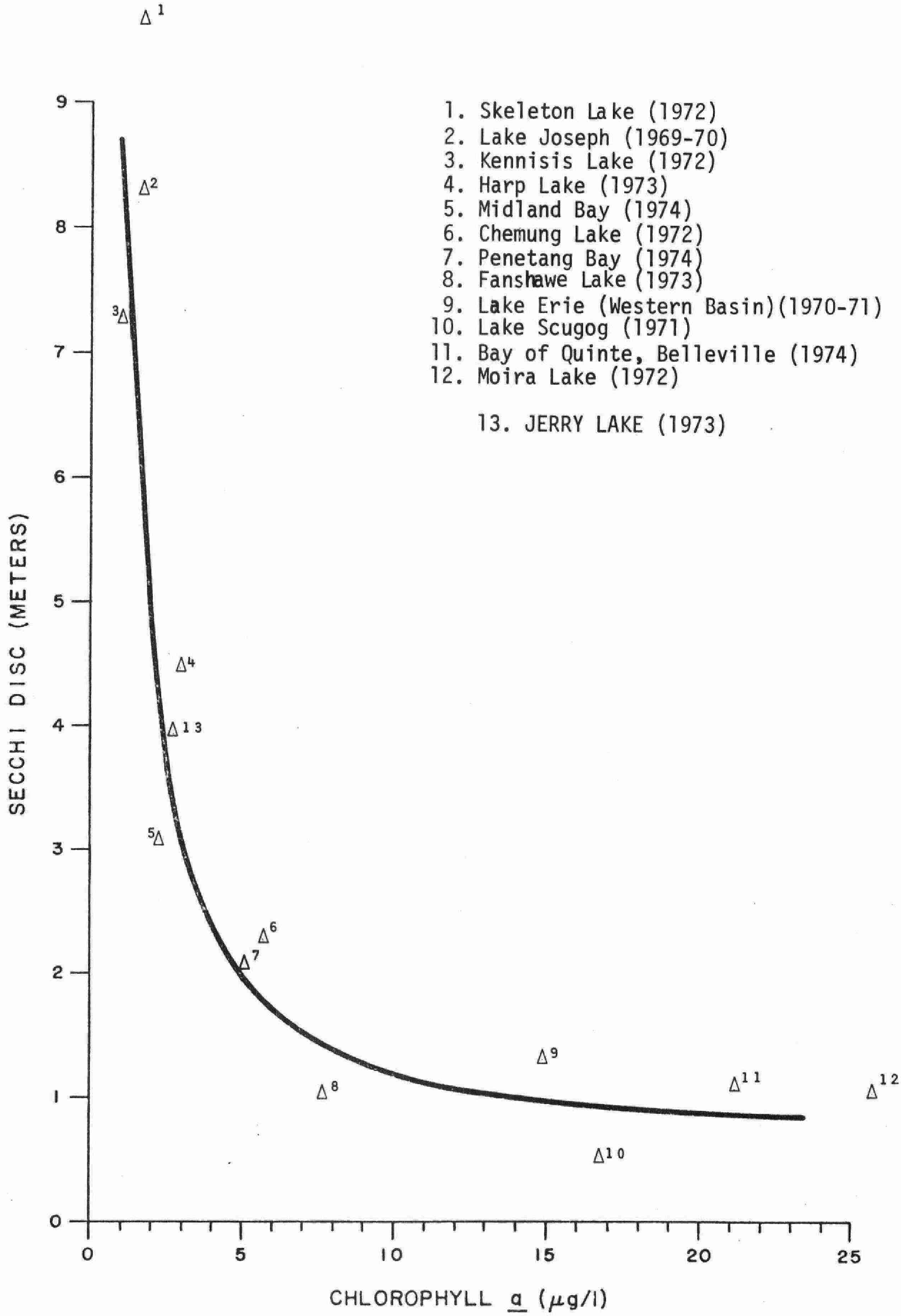


Figure 19 : The mean of chlorophyll a and Secchi disc measurements in Jerry Lake relative to a curve describing the chlorophyll a-Secchi disc relationship in many Ontario lakes. Twelve other Ontario lakes are included for comparison with Jerry Lake. (See p. A-6 for an explanation of the above relationship).

It is noteworthy that the major shoreline area of weed growth is located on the delta of the major inflowing stream at the northeast end of the lake. A substrate of suitable texture and fertility for aquatic plants in this area of Jerry Lake has likely built up over the years as a result of deposition of sediment from the adjacent inflowing stream. Nutrient input from the stream probably helps to maintain the growth of aquatic plants in the delta area. The three remaining weed beds are located in shallow bays and in the outflow region (Figure 20).

Most of the plants identified from Jerry Lake inhabit a wide variety of lake types; however, water lobelia and pipewort are generally only found on sandy bottoms of softwater lakes and the presence of these two species in Jerry Lake is a confirmation of the low hardness and alkalinity values measured in the lake. It is also noteworthy that weedy species such as water milfoil, coontail and Canada waterweed, notoriously common in nutrient enriched lakes, were not found in Jerry Lake.

FIGURE 20 - MAJOR AREAS OF SHORELINE AQUATIC PLANT GROWTH IN JERRY LAKE

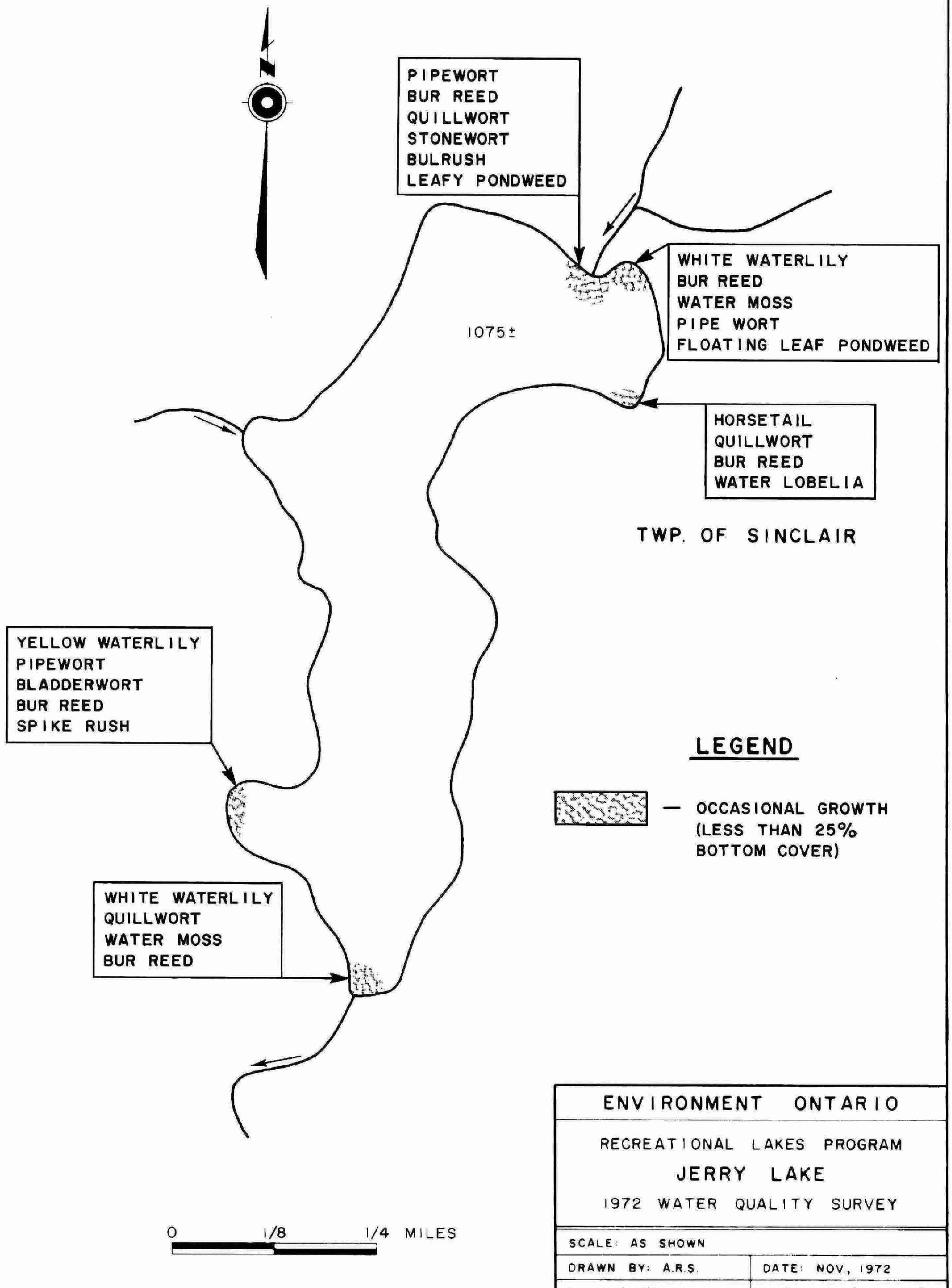


TABLE 4: A list of shoreline aquatic plants found in Jerry Lake and the number of areas in which each type occurred. For convenience, the plants are divided into two categories: (a) submergent - aquatic plants which live for the most part underwater and (b) emergent-plants which produce floating or aerial leaves.

Scientific name (Genus, species)	Common name(s)	Distribution (number of areas)
(a) SUBMERGENT		
Fontinalis sp.	Water moss	2
Nitella sp.*	Stonewort	1
Isoetes sp.	Quillwort	3
Potamogeton epihydrus	Leafy pondweed	1
Potamogeton natans	Floating-leaf pondweed	1
Utricularia vulgaris	Bladderwort	1
(b) EMERGENT		
Eleocharis acicularis	Spike rush	1
Eriocaulon sp.	Pipewort	3
Equisetum sp.	Horsetail	1
Nuphar sp.	Yellow waterlily	1
Nymphaea sp.	White waterlily	2
Lobelia dortmanna	Water lobelia	1
Scirpus sp.	Bulrush	1
Sparganium sp.	Bur reed	5

* *Nitella* is technically an alga, but because it grows in long strands, it is often called an aquatic plant.

INFORMATION OF GENERAL INTEREST TO COTTAGERS

MICROBIOLOGY OF WATER

For the sake of simplicity, the micro-organisms in water can be divided into two groups: the bacteria that thrive in the lake environment and make up the natural bacterial flora; and the disease causing micro-organisms, called pathogens, that have acquired the capacity to infect human tissues.

The "pathogens" are generally introduced to the aquatic environment by raw or inadequately treated sewage, although a few are found naturally in the soil. The presence of these bacteria does not change the appearance of the water but poses an immediate public health hazard if the water is used for drinking or swimming. The health hazard does not necessarily mean that the water user will contract serious waterborn infections such as typhoid fever, polio or hepatitis, but he may catch less serious infections of gastro-enteritis (sometimes called stomach flu), dysentery or diarrhea. Included in these minor afflictions are eye, ear and throat infections that swimmers encounter every year and the more insidious but seldom diagnosed, sub-clinical infections usually associated with several waterborn viruses. These viral infections leave a person not feeling well enough to enjoy holidaying although not bedridden. This type of microbial pollution can be remedied by preventing wastes from reaching the lake and water quality will return to satisfactory conditions within a relatively short time (approximately one year) since disease causing bacteria usually do not thrive in an aquatic environment.

The rest of the bacteria live and thrive within the lake environment. These organisms are the instruments of biodegradation. Any organic matter in the lake will be used as food by these organisms and will give rise, in turn to subsequent increases in their numbers. Natural organic matter as well as that from sewage, kitchen wastes, oil and gasoline are readily attacked by these lake bacteria. Unfortunately, biodegradation of the organic wastes by organisms uses correspondingly large amounts of the dissolved oxygen. If the organic matter content of the lake gets high enough, these bacteria will deplete the dissolved oxygen supply in the bottom waters and threaten the survival of many deep-water fish species.

RAINFALL AND BACTERIA

The "Rainfall Effect" referred to in the text, relates to a phenomenon that has been documented in previous surveys of the Recreational Lakes. Heavy precipitation has been shown to flush the land area around the lake and the subsequent runoff will carry available contaminants including sewage organisms as well as natural soil bacteria with it into the water.

Total coliforms, fecal coliforms and fecal streptococci, as well as other bacteria and viruses which inhabit human waste disposal systems, can be washed into the lake. In Precambrian areas where there is inadequate soil cover and in

fractured limestone areas where fissures in the rocks provide access to the lake, this phenomenon is particularly evident.

Melting snow provides the same transportation function for bacteria, especially in an agricultural area where manure spreading is carried out in the winter on top of the snow.

Previous data from sampling points situated 50 to 100 feet from shore indicate that contamination from shore generally shows up within 12 to 48 hours after a heavy rainfall.

WATER TREATMENT

Lake and river water is open to contamination by man, animals and birds (all of which can be carriers of disease); consequently, NO SURFACE WATER MAY BE CONSIDERED SAFE FOR HUMAN CONSUMPTION without prior treatment, including disinfection. Disinfection is especially critical if coliforms have been shown to be present.

Disinfection can be achieved by:

(a) Boiling

Boil the water for a minimum of five minutes to destroy the disease causing organisms.

(b) Chlorination using a household bleach containing 4 to 5¼ percent available chlorine.

Eight drops of a household bleach solution should be mixed with one gallon of water and allowed to stand for 15 minutes before drinking.

(c) Continuous Chlorination

For continuous water disinfection, a small domestic hypochlorinator (sometimes coupled with activated charcoal filters) can be obtained from a local plumber or water equipment supplier.

(d) Well Water Treatment

Well water can be disinfected using a household bleach (assuming strength at 5 percent available chlorine) if the depth of water and diameter of the well are known.

CHLORINE BLEACH
Per 10 ft. Depth of Water

Diameter of Well Casing in Inches	One to Ten Coliforms	More Than Ten Coliforms
4	0.5 oz.	1 oz.
6	1 oz.	2 oz.
8	2 oz.	4 oz.
12	4 oz.	8 oz.
16	7 oz.	14 oz.
20	11 oz.	22 oz.
24	16 oz.	31 oz.
30	25 oz.	49 oz.
36	35 oz.	70 oz.

Allow about six hours of contact time before using the water.

Another bacteriological sample should be taken after one week of use.

Water Sources (spring, lake, well, etc.) should be inspected for possible contamination routes (surface soil, runoff following rain and seepage from domestic waste disposal sites). Attempts at disinfecting the water alone without removing the source of contamination will not supply bacteriologically safe water on a continuing basis.

There are several types of low cost filters (ceramic, paper, carbon, diatomaceous earth sometimes impregnated with silver, etc.) that can be easily installed on taps or in water lines. These may be useful to remove particles, if water is periodically turbid, and are usually very successful. Filters, however, do not disinfect water but may reduce bacterial numbers. For safety, chlorination of filtered water is recommended.

SEPTIC TANK INSTALLATIONS

In Ontario, provincial law requires under Part 7 of the Environment Protection Act that before you extend, alter, enlarge or establish any building where a sewage system will be used, a Certificate of Approval must be obtained from the Ministry of the Environment or its representatives. The local municipality or Health Unit may be delegated the authority to issue the Certificate of Approval. Any other pertinent information such as size, types and location of septic tanks and tile fields can also be obtained from the same authority.

(1) General Guidelines

A septic tank should not be closer than:

-50 feet to any well, lake, stream, pond, spring, river or reservoir

-5 feet to any building
-10 feet to any property boundary

The tile field should not be closer than:

-100 feet to the nearest dug well
-50 feet to a drilled well which has a casing to 25 feet below ground
-25 feet to a building with a basement that has a floor below the level of the tile in the tile bed
-10 feet to any other building
-10 feet to a property boundary
-50 feet to any lake, stream, pond, spring, river or reservoir

The ideal location for a tile field is in a well-drained, sandy loam soil remote from any wells or other drinking water sources. For the tile field to work satisfactorily, there should be at least 3 feet of soil between the bottom of the weeping tile trenches and the top of the groundwater table or bedrock.

Recognizing that private sewage systems are relatively inefficient where shallow and inappropriate soil conditions are present (e.g. Precambrian areas) the Ministry of the Environment is conducting research into alternate methods of private sewage disposal in unsewered areas; into the improvement of existing equipment and methods of design and operation for these systems; and into the development of better surveillance methods such as by the use of chemical, biological and radioactive tracers to detect the movement of pollutants through the soil mantle.

DYE TESTING OF SEPTIC TANK SYSTEMS

There is considerable interest among cottage owners to dye test their sewage systems; however, several problems are associated with dye testing. Dye would not be visible to the eye from a system that has a fairly direct connection to the lake. Thus, if a cottager dye-tested his system and no dye was visible in the lake, he would assume that his system is satisfactory, which might not be the case. A low concentration of dye is not visible and therefore expensive equipment such as a fluorometer is required. Only qualified people with adequate equipment are capable of assessing a sewage system by using dye. In any case, it is likely that some of the water from a septic tank will eventually reach the lake. The important question is whether all contaminants including nutrients have been removed before it reaches the lake. To answer this question special knowledge of the system, soil depth and composition, underground geology of the region and the shape and flow of the shifting water table are required. Therefore, we recommend that this type of study should be performed only by qualified professionals.

BOATING AND MARINA REGULATIONS

In order to help protect the lakes and rivers of Ontario from pollution, it is required by law that sewage (including garbage) from all pleasure craft, including houseboats, must be retained in suitable equipment. Equipment which is considered suitable by the Ministry of the Environment includes (1) retention devices with or without re-circulation which retain all toilet wastes for disposal ashore, and (2) incinerating devices which reduce all sewage to ash.

Equipment for storage of toilet wastes shall:

1. be non-portable
2. be constructed of structurally sound material
3. have adequate capacity for expected use
4. be properly installed, and
5. be equipped with the necessary pipes and fittings conveniently located for pump-out by shore-based facilities (although not specified, a pump-out deck fitting with 1½-inch diameter National Pipe Thread is commonly used).

An Ontario regulation requires that marinas and yacht clubs provide or arrange pump-out service for the customers and members who have toilet-equipped boats. In addition, all marinas and yacht clubs must provide litter containers that can be conveniently used by occupants of pleasure boats.

The following "Tips" may be of assistance to you in boating:

1. Motors should be in good mechanical condition and properly tuned.
2. When a tank for outboard motor testing is used, the contents should not be emptied into the water.
3. If the bilge is cleaned, the waste material must not be dumped into the water.
4. Fuel tanks must not be overfilled and space must be left for expansion if the fuel warms up.
5. Vent pipes should not be obstructed and fuel needs to be dispensed at a correct rate to prevent "blow-back".
6. Empty oil cans must be deposited in a leak-proof receptable, and,
7. Slow down and save fuel.

EUTROPHICATION OR EXCESSIVE FERTILIZATION AND LAKE PROCESSES

In recent years, cottagers have become aware of the problems associated with nutrient enrichment of recreational lakes and have learned to recognize many of the symptoms characterizing nutrient enriched (eutrophic) lakes. It is important to realize that small to moderate amounts of aquatic plants and algae are necessary to maintain a balanced aquatic environment. They provide food and a suitable environment for the growth of aquatic invertebrate organisms which serve as food for fish. Shade from large aquatic plants helps to keep the lower water cool, which is essential to certain species of fish and also provides protection for young game and forage fish. Numerous aquatic plants are utilized for food and/or protection by many species of waterfowl. However, too much growth creates an imbalance in the natural plant and animal community particularly with respect to oxygen conditions, and some desirable forms of life such as sport fish are eliminated and unsightly algae scums can form. The lake will not be "dead" but rather abound with life which unfortunately is not considered aesthetically pleasing. This change to poor water quality becomes apparent after a period of years during which extra nutrients are added to the lake and return to the natural state may also take a number of years after the nutrient inputs are stopped.

Changes in water quality with depth are a very important characteristic of the lake. Water temperatures are uniform throughout the lake in the early spring and winds generally keep the entire volume well mixed. Shallow lakes may remain well mixed all summer so that water quality will be the same throughout. On the other hand, in deep lakes, the surface waters warm up during late spring and early summer and float on the cooler more dense water below. The difference in density offers a resistance to mixing by wind action and many lakes do not become fully mixed again until the surface waters cool down in the fall. The bottom water receives no oxygen from the atmosphere during this unmixed period and the dissolved oxygen supply may be all used up by bacteria as they decompose organic matter. Cold water fish, such as trout, will have to move to the warm surface waters to get oxygen and because of the high water temperatures they will not thrive, so that the species will probably die out (see Figure next page).

Low oxygen conditions in the bottom waters are not necessarily an indication of pollution but excessive aquatic plant and algae growth and subsequent decomposition in the bottom waters can aggravate the condition and in some cases result in zero oxygen levels in lakes which had previously held some oxygen in the bottom waters all summer. Although plant nutrients normally accumulate in the bottom waters of the lakes, they do so to a much greater extent if there is no oxygen present. These nutrients become available for algae in the surface waters when the lake mixes in the fall and dense algae growths can result.

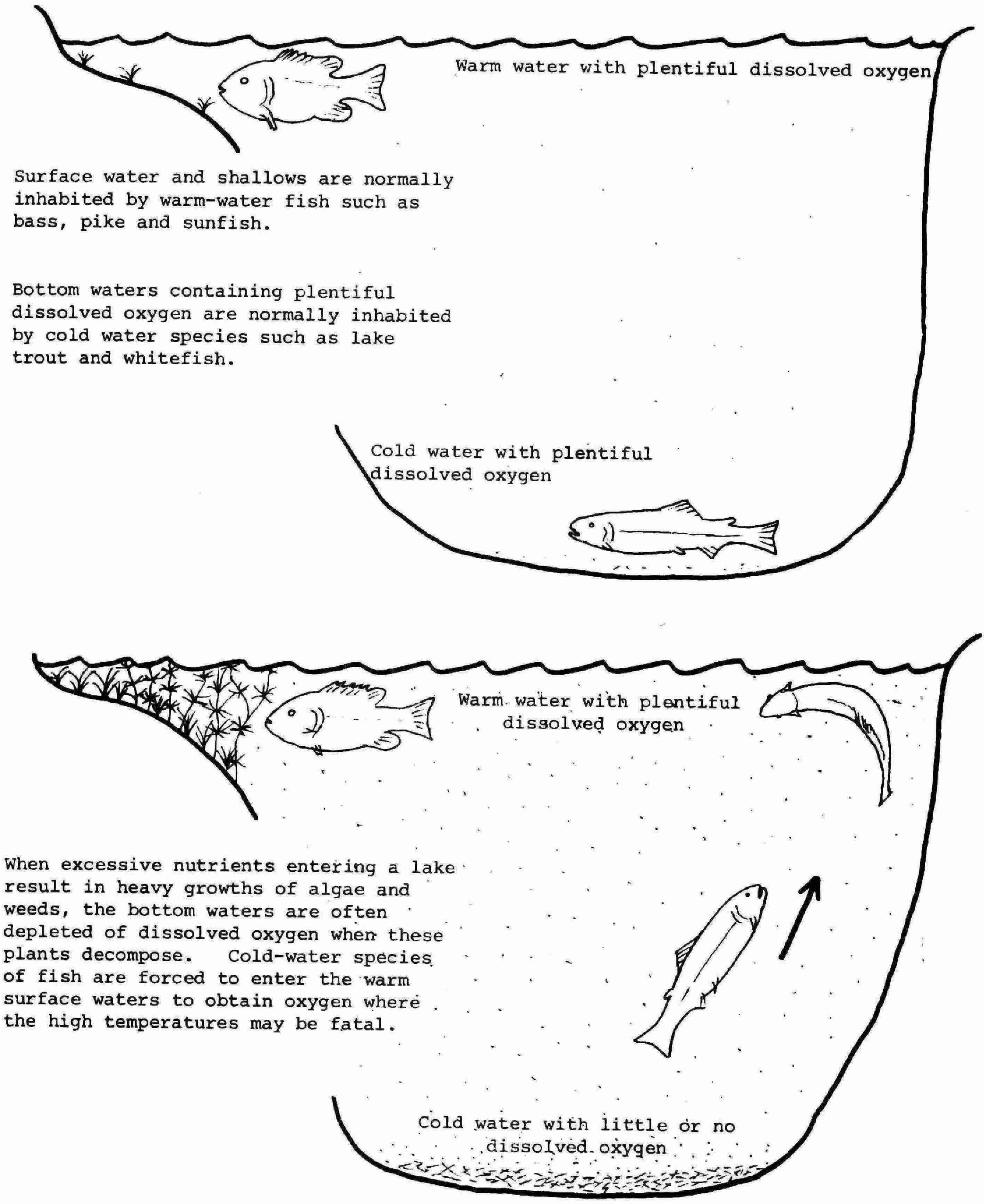


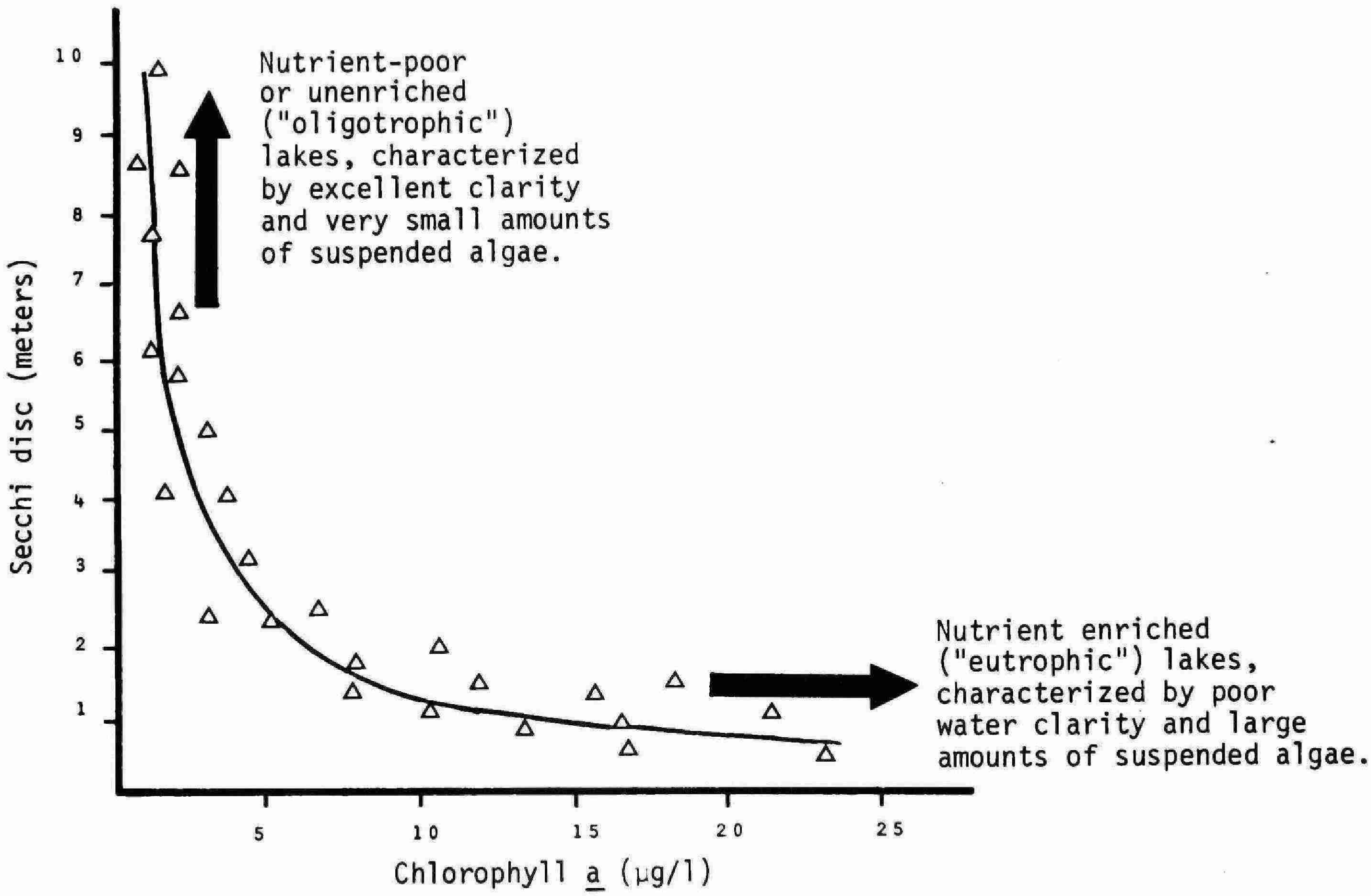
FIGURE A-1: DECOMPOSITION OF PLANT MATTER AT THE LAKE BOTTOM CAN LEAD TO DEATH OF DEEP-WATER FISH SPECIES.

Consequently, lakes which have no oxygen in the bottom water during the summer are more prone to having algae problems and are more vulnerable to nutrient inputs than lakes which retain some oxygen.

Like humans, aquatic plants and algae require a balanced "diet" for growth. Other special requirements including those for light and temperature are specific for certain algae and plants. Chemical elements such as nitrogen, phosphorus, carbon, and several others are required and must be in forms which are available for uptake by plants and algae. Growth of algae can be limited by a scarcity of any single "critical" nutrient. Nitrogen and phosphorus are usually considered "critical" nutrients because they are most often in scarce supply in natural waters, particularly in lakes in the Precambrian area of the province. Phosphorus, especially is necessary for the processes of photosynthesis and cell division. Nitrogen and phosphorus are generally required in the nitrate-N (or ammonia-N) and phosphate forms and are present in natural land runoff and precipitation. Human and livestock wastes are a very significant source of these and other nutrients for lakes in urban and agricultural areas. It is extremely important that cottage waste disposal systems function so that seepage of nutrients to the lake does not occur since the changes in water quality brought about by excessive inputs of nutrients to lakes are usually evidenced by excessive growths of algae and aquatic plants.

The large amounts of suspended algae which materialize from excessive inputs of nutrients, result in turbid water of poor clarity or transparency. On the other hand, lakes with only small, natural inputs of nutrients and correspondingly low nutrient concentrations (characteristically large and deep lakes) most often support very small amounts of suspended algae and consequently, are clear-water lakes. An indication of the degree of enrichment of lakes can therefore be gained by measuring the density of suspended algae (as indicated by the chlorophyll *a* concentration - the green pigment in most plants and algae) and water clarity (measured with a Secchi disc). In this regard, staff of the Ministry of the Environment have been collecting chlorophyll *a* and water clarity data from several lakes in Ontario and have developed a graphical relationship between these parameters which is being used by cottagers to further their understanding of the processes and consequences of nutrient enrichment of Precambrian lakes. The figure on the next page illustrates the above-mentioned relationship.

In the absence of excessive coloured matter (eg. drainage from marshlands), lakes which are very low in nutrients are generally characterized by small amounts of suspended algae (i.e. chlorophyll *a*) and are clear-water lakes with high Secchi disc values. Such lakes, with chlorophyll *a* and Secchi disc values lying in the upper left-hand area of the graph are unenriched or nutrient poor ("oligotrophic") in status and do not suffer from the problems associated with excessive inputs of nutrients. In contrast, lakes with high chlorophyll *a* concentrations and poor clarity are positioned in the lower right-hand area of the graph and are enriched ("eutrophic"). These lakes usually exhibit symptoms of excessive nutrient enrichment including water turbidity owing to large amounts of suspended algae which may float to the surface and accumulate in sheltered areas around docks and bays.



Measurements of suspended algal density (chlorophyll a) and water clarity are especially valuable if carried out over several years. Year to year positional changes on the graph can then be assessed to determine whether or not changes in lake water quality are materializing so that remedial measures can be implemented before conditions become critical.

CONTROL OF AQUATIC PLANTS AND ALGAE

Usually aquatic weed growths are heaviest in shallow shoreline areas where adequate light and nutrient conditions prevail.

Extensive aquatic plant and algal growths sometimes interfere with boating and swimming and ultimately diminish shoreline property values.

Control of aquatic plants may be achieved by either chemical or mechanical means. Chemical methods of control are currently the most practical, considering the ease with which they are applied. However, the herbicides and algicides currently available generally provide control for only a single season. It is important to ensure that an algicide or herbicide which kills the plants causing the nuisance, does not affect fish or other aquatic plants. Chemical control in the province is regulated by the Ministry of the Environment and a permit must be granted prior to any operation. Simple raking and chain dragging operations to control submergent species have been successfully employed in a number of situations; however, the plants soon re-establish themselves. Removal of weeds by underwater mowing techniques is certainly the most attractive method of control and is currently being evaluated in Chemung Lake near Peterborough. Guidelines and summaries of control methods, and applications for permits are available from the Pesticides Control Section, Pollution Control Branch, Ministry of the Environment, 135 St. Clair Avenue West, Toronto, Ontario M4V 1P5.

PHOSPHORUS AND DETERGENTS

Scientists have recognized that phosphorus is the key nutrient in stimulating algal growth in lakes and streams.

In past years, approximately 50 percent of the phosphorus contributed by municipal sewage was added by detergents. Federal regulations reduced the phosphate content (as P_2O_5) in laundry detergents from approximately 50 percent to 20 percent on August 1, 1970 and to 5 percent on January 1, 1973.

It should be recognized that automatic dishwashing compounds were not subject to the government regulations and that surprisingly high numbers of automatic dishwashers are present in resort areas (a questionnaire indicated that about 30 percent of the cottages in the Muskoka lakes have automatic dishwashers). Cottagers utilizing such conveniences may be contributing significant amounts of phosphorus to recreational lakes because automatic dishwashing compounds are characteristically high in phosphorus. Indeed, in most of Ontario's vacation land, the source of domestic water is soft enough to allow the exclusive use of liquid dishwashing compounds, soap and soap-flakes which are, in general, relatively low in phosphorus.

ONTARIO'S PHOSPHORUS REMOVAL PROGRAMME

By 1975, the Government of Ontario expects to have controls in operation at more than 200 municipal wastewater treatment plants across the province serving some 4.7 million persons. This represents about 90 percent of the population serviced by sewers. The programme is in response to the International Joint Commission recommendations as embodied in the Great Lakes Water Quality Agreement and studies carried out by the Ministry of the Environment on inland recreational waters which showed phosphorus to be a major factor influencing eutrophication. Specifically, the programme makes provision for nutrient control in the Upper and Lower Great Lakes, the Ottawa River system and in prime recreational waters where the need is demonstrated or where emphasis is placed upon prevention of localized, accelerated eutrophication.

Phosphorus removal facilities became operational at wastewater treatment plants on December 31, 1973, in the most critically affected areas of the province, including all the plants in the Lake Erie drainage basin and the inland recreational areas. The operational date for plants discharging to waters deemed to be in less critical condition, which includes plants larger than one million gallons per day (1 mgd) discharging to Lake Ontario and to the Ottawa River system, is December 31, 1975. The 1973 phase of the programme involved 113 plants, of which 48 are in prime recreational areas. An additional 53 new plants, each with phosphorus removal, are now under development, 23 of which are located in recreational areas. The capacities of these plants range from 0.04 to 24.0 mgd, serving an estimated population of 1,600,000 persons.

The 1975 phase will bring into operation another 54 plants ranging in size from 0.3 to 180 mgd serving an additional 3,100,00 persons. Treatment facilities utilizing the Lower Great Lakes must meet effluent guidelines of less than 1.0 milligram per litre of total phosphorus in their final effluent. Facilities utilizing the Upper Great Lakes, the Ottawa River Basin and certain areas of Georgian Bay where needs have been demonstrated must remove at least 80 percent of the phosphorus reaching their sewage treatment plants.

CONTROL OF BITING INSECTS

Mosquitoes and blackflies often interfere with the enjoyment of recreational facilities at the lake-side vacation property. Pesticidal spraying or fogging in the vicinity of cottages produces extremely temporary benefits and usually do not justify the hazard involved in contaminating the nearby water. Eradication of biting fly populations is not possible under any circumstances and significant control is rarely achieved in the absence of large-scale abatement programs involving substantial funds and trained personnel. Limited use of approved larvicides in small areas of swamp or in rain pools close to residences on private property may be undertaken by individual landowners, but permits are necessary wherever treated waters may contaminate adjacent streams or lakes. The use of repellents and light traps is encouraged as are attempts to reduce mosquito larval habitat by improving land drainage. Applications for permits to apply insecticides as well as technical advice can be obtained from the Ministry of the Environment, Pesticides Control Service, 3rd Floor, 1 St. Clair Avenue West, Toronto, Ontario.